GAS JOURNAL, MARCH 12, 1941

VOL. 233 93rd YEAR No. 4060

EDITORIAL NOTES

NAPHTHALENE FOR MOTOR TRANSPORT

IN our issue of Feb. 12 we wrote on the subject of using naphthalene for imported fuel oils, for motor transport.

During the last war the use of naphthalene was suggested as one of the practicable solutions of the motor fuel problem—naphthalene having the great advantage of cheapness. We referred among other work to that undertaken by Messrs. J. H. Willis and G. G. Wilson, then of the Birmingham Gas Department, who pointed out that there was no need to use commercially pure naphthalene for the purpose, and we recalled an article by Mr. Willis, published in the "JOURNAL" during the latter part of the war ("JOURNAL" of Jan. 8, 1918). Our comments having created considerable interest we have thought it desirable in present circumstances to reprint that article, and it will be found on later pages of our issue to-day. Actually the Author has made some very slight modifications to it, but it is substantially the same. One of the modifications is that thermostatic control of naphthalene temperature is considered essential to future development, as, in point of fact, it was so considered at the time when the experiments described in the article were carried out. The temperature of the molten naphthalene should be kept as constant as possible owing to the considerable rise in vapour pressure consequent upon a comparatively slight increase in temperature. That the tone of the article was optimistic will be gathered from the single sentence : "The use of naphthalene as a fuel for small engines can be greatly extended, and attempts which war conditions have provoked are likely to end in the ultimate adoption of naphthalene as a fuel for commercial motor vehicles." It would appear that the matter was not pursued to any extent on the resumption of peace, but now, under wartime conditions once again, further work on the subject seems to be indicated. We know that the investigators to whom we have referred are quite unable at the present juncture to devote the necessary time to the proposition. Perhaps one of the Research Committees might consider the advisability of carrying on where Messrs. Willis and Wilson left off. Further development of the original method could to advantage, we suggest, be made in the first place through the medium of existing types of stationary oil engine, preferably those with a fairly constant load. Its use for internal combustion engines of the type installed for heavy transport (where the loads are extremely variable) would be a further step for investigation and development.

FACTORY ACCIDENTS AND LIGHTING

THE delay in the presentation of the Annual Report of H.M. Chief Inspector of Factories for the year 1939 is in the circumstances understandable enough—pressure on all members of the Factory Inspectorate through war work. It has, however, now been published and there are many points in it of great interest, and we are glad that the decision was not taken to publish only the briefest of brief reports. Actually the report has been cut down to much smaller dimensions than usual and some of the statistical tables have been omitted, but the various features of 1939 set out, including events preceding the war, form an instructive comparison. In the early months of the year the new Act which came into operation in July, 1938, was rapidly becoming familiar, and Employers' Associations and Trade Unions took an interest in spreading knowledge of the Act "to a degree which was unheard of in any previous factory legislation." Occupiers of factories were falling into line, and "something like a new order in working conditions was being inaugurated."

From September, of course, industrial activity was carried on at high pressure under conditions which might be expected to cause a serious number of accidents. Statistics given, however, are not, considering the circumstances, discouraging. One would naturally expect an increase in accidents in wartime, due to such causes as increase in the number employed and extension of hours of employment, the rapid influx of new workers, a tendency to neglect safety precautions in a patriotic endeavour to get things done quickly, the added risk due to fatigue and to persons working under mental stress due to general war conditions—and then, of course, the blackout. Many factories were not at all properly prepared for this; under the immediate pressure of the Defence Regulations, large numbers of factories were blacked out without sufficient thought as to the interference which would result to ventilation and natural lighting. Improvement has since been made, and we have had the reports of the Departmental Committee on the Lighting of Factories, the latest report, covering both natural and artificial illumination, being issued in the summer of 1940. We dealt fully with this in the "JOURNAL" at the time, calling attention to the recommendation that a minimum of illumination of 6 foot-candles at 3 ft. above floor level should be attained (this comparing with the previous recommendation of 1.0 foot-candle).

The Factories (Standards of Lighting) Regulations, 1941, have now been made by the Minister of Labour and National Service under section 5 of the 1937 Factories Act. This states that the general illumination over those interior parts of the factory where persons are regularly employed must not be less than 6 foot-candles measured in a horizontal plane at a level of 3 ft. above the floor, provided—we quote from the Regulations (S.R. & O., 1941, No. 94)—"that in any such parts in which the mounting height of the light sources for general illumination necessarily exceeds 25 ft. measured from the floor or where the structure of the room or the position or construction of the fixed machinery or plant prevents the uniform attainment of this standard, the general illumination at the said level shall be not less than 2 foot-candles, and where work is actually being done the illumination shall not be less than 6 foot-candles, or the greatest reasonably practicable illumination below 6 foot-candles." In regard to interior parts over which persons employed are liable to pass, the illumination is to be 0.5 foot-candle. The regulation concerning the 6 foot-candle illumination does not apply to gas-works; but gas undertakings as purveyors of a source of light (at the same time a source of heat and ventilation) can do—and indeed have done—a great deal to help, in co-operation with the manufacturers of lighting equipment, factory owners and managers in this respect.

Factory accidents are linked up largely with adequate lighting properly applied. Comparing the six months September, 1938, to February, 1939, and the six months September, 1939, to February, 1940, the increase in fatal accidents amounted to 42%, and the largest increase in fatalities was in respect of people falling—always the most prolific cause of fatal accidents.

§§§

THE THING THAT MATTERS

SOME of the " talkie-picture " advertisements by the aid of which the Government are to so considerable an extent making appeal to the patriotism and good sense of the public may at first sight appear to be extreme in their simplicity, but there can be no doubt that even those which are most simple possess ability to arrest the eye that comes within their range, and thereby secure attention. It may at once be admitted, of course, that in some degree the attention thus secured is due to the theme—the subject that is with us in all our hours of consciousness. But that comes after the eye has registered its response to the appeal. The Government have been by no means the first to recognize the power of Press announcements of the type in which the appeal is first to the eye, but the large scale adoption by them of this method of "teaching without tears" must act as a great encouragement to publicists in other fields—whether household commodities, toilet requisites, or industrial plant and appliances such as one sees advertised on so many pages of each week's issue of the "JOURNAL." If this "appeal to the eye" is deemed to be so valuable to those who are occupied in guiding the country through the most momentous period in its history, it should be good enough for the rest of us.

As a matter of fact, it was an "eye appeal" of this character which led us a few days ago to read through a "family conversation" included in a Press announcement by the National Savings Committee. In the course of this conversation the father is made to say: "Helping to win the war is the thing that matters these days." The all-important message ! The foremost earthly thing upon which we must keep our minds fixed. For if we failed in that one thing, all other aims and ambitions would be superfluous. In one way or another, according to our opportunities and our ability, both individually and collectively we must all of us be ever helping to win the war. Those who are actively associated with the Gas Industry will consider themselves fortunate in that the contribution which they and their Industry are making towards the winning of the war is so powerful. Largely this contribution may be taken as a matter of course—that is, to the extent to which it may be embraced in "good service." But there is also a great part which is beyond this—work which the Gas Industry performs in a manner as efficient as it is unassuming. Never claiming an undue—if even a fair—share of the "limelight," our Industry will be content to be judged strictly by its deeds, not by a measure any less than this.

And as with our Industry, so with ourselves. We must press forward—remembering that nothing is enough; the possibility of further accomplishment lies ever ahead. The great feats that are being performed in all directions must be followed by still greater ones—all leading towards one goal. For "helping to win the war is the thing that matters these days."

Defence (Gas Charges) Order

An interesting point in connexion with the operation of the Defence (Gas Charges) Order has been made by Mr. W. Lees Stenning, Chairman of the East Surrey Gas Company. The hope had been expressed, he said, that the 1939 Order—designed to relieve the inequitable operation under war conditions of the sliding-scale on dividends in so far as companies with a decreased output were concerned—would be supplemented by assistance for companies whose output had risen, but whose price of gas had increased owing to the higher cost of coal, oil, materials, and labour. In fact, a further Order was promulgated in 1940, the dividend relief afforded being measured by the increased net cost of coal and oil. Several conditions had to be satisfied before advantage could be taken of the Order, and no relief was given in so far as the dividend, as determined by the undertaking's sliding-scale, declined by 1% or less. Modification of the Order became increasingly necessary, for the continued rise in the cost of labour and materials prevented a gas undertaking with an increased output from keeping (as the Order required) its revenue expenditure on the repair and maintenance of works and plant within the average expenditure of the years 1936, 1937, and 1938. Moreover, it was difficult to justify the requirement that no relief could be afforded until the reduction of dividend under the sliding-scale exceeded 1%, for such reduction automatically followed the inevitable rise in the price of gas brought about by conditions entirely beyond the control of the company.

A Point of Equity

As is the case with the Gas Industry elsewhere, work of vital importance to the Australian Commonwealth is being performed by the Colonial Gas Association, Ltd., who thereby assuredly deserve well of the authorities. To an ever-increasing extent (as figures from the accounts quoted on p. 166 of the "JOURNAL" dated Oct. 23 last showed), the Association provide, as their daily task, one of the foremost utility services of modern life; and now, in addition, they are being called upon—as is, again, the case elsewhere—for a contribution of another kind, inasmuch as the Government have appealed for the installation of plants for the extraction of benzole from the gas, in order to supplement the local supply of motor spirit. The Association naturally made prompt response to this appeal by arranging for the necessary plant to be provided at their largest manufacturing station. In view of the Australian Government's declaration that, in the present emergency, "the best contribution that can be made by the Gas Industry is to augment supplies of motor spirit," and of this ready acquiescence, superimposed upon the normal services of the Association, it seems somewhat strange to read the following in the address from the Chair at the annual meeting of shareholders: "In Queensland, electrical undertakings enjoy, by permission of the authorities, tariffs under which "stand-by" users pay their due proportion of the annual cost of providing the service, as distinct from the cost of generation of electricity. Unfortunately, the Gas Industry does not there enjoy the same consideration, and attempts to get approval for more equitable and promotional gas tariffs have not met with success." Is there not a nice point of equity involved here ?

Personal

Heartiest congratulations to Mr. J. H. WILSON, Chairman and Managing Director of Messrs. George Wilson Gas Meters, Ltd., on receiving Commendation for "gallant conduct on the night of Nov. 14–15, when he displayed great courage and leadership throughout the heavy enemy attack on the City."

* * *

The name of Mr. JAMES JAMIESON, Engineer and Manager of the Edinburgh Corporation Gas Department, appears in the list of those elected Fellows of the Royal Society of Edinburgh at a meeting held on March 3.

Obituary

The death is announced at his residence, Bray, County Wicklow, of Mr. JAMES DOWLING, former Manager of the Gas-Works at Westport and Malahide.

* * *

The sympathy of his many friends in the Gas Industry will be extended to Mr. Eric C. Mengel, Director of Messrs. Humphreys & Glasgow, Ltd., in the loss, on active service, of his only son, John Percival Mengel, who was 26 years old and a Second Lieutenant in the Royal Berkshire Regiment. The funeral took place at Paddington New Cemetery, Mill Hill, on March 5.

* * *

The death has taken place, at the age of 63, of Mr. J. C. WILSON, a Director of the Kettering Gas Company.

On Monday, March 17, at Gas Industry House, there will be meetings of the London and Counties Coke Association as follows: Finance Committee, 11 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 2.30 p.m.

A Meeting of the Scottish Junior Gas Association (Western District) will be held at the Heriot Watt College, Edinburgh, at 3 p.m. on Saturday, March 15. The speaker will be Mr. A. F. Pollock, of Edinburgh Gas Department, and his subject is "Some Aspects of Office Organization in a large Gas Undertaking."

A Series of Lectures and demonstrations has been given at St. Cuthbert's Co-operative Association, Edinburgh, at the request of the Food Economy Division of the Ministry of Food. The meetings were organized by Mr. J. Dick, General Manager, with the co-operation of the Ministry of Food, Edinburgh Education Department, and Edinburgh Corporation Gas Department. Five meetings were held, and included exhibitions of Ministry of Information films.

It is the Intention of the Ormskirk District Gas Company to apply to the Board of Trade for a Special Order under Section I of the Gas Undertakings Act, 1929, to authorize the Company to raise by the creation and issue of preference shares or stock capital an amount not exceeding £10,000 in addition to any capital the Company are already authorized to raise under existing Orders.

Notice is Given by the Ambergate, Crich, Bull Bridge, and Fritchley Gas Company of their intention to apply to the Board of Trade for a Special Order under the Gas Undertakings Acts, 1920 to 1934, to authorize the Company to supply gas in certain specified areas in the County of Derby, and for various other purposes, including provisions relating to capital and borrowing powers and the utilization of lands for gas-works purposes.

National Gas Council Staff

MR. L. F. STEMP.

Our readers will be interested to know that the Central Executive Board of the National Gas Council at its last meeting gave titles to two members of the staff of the Council.

In the first place Mr. Leslie F. Stemp, who was appointed in March, 1926, and has assisted Mr. Ogilvie in connexion with legal and Parliamentary matters, has been given the title of "Legal Adviser" to the National Gas Council.

MR. H. T. SEYMOUR.

Mr. H. T. Seymour, A.C.I.S., A.L.A.A., was appointed in March, 1919, and has kept the accounts of the Council and the various Organizations and Bodies which have been connected with its work for the last 22 years. Mr. Seymour now receives the title of "Accountant" to the National Gas Council.

Neither of these titles carries with it any increased emolument, the titles being given in recognition of the services rendered by these two Officers.

Radiation Ltd.

Change of London Addresses.

The London offices and showrooms of the following Radiation Companies are now centralized at 7, Stratford Place, London, W.1 (opposite Bond Street Tube):

	Telephone.
Arden Hill & Co., Ltd.	Mayfair 6466.
Davis Gas Stove Co., Ltd.	,, 6462.
Eagle Range & Grate Co., Ltd. ..	,, 6466.
Fletcher Russell & Co., Ltd. } ..	,, 6467.
Wilsons & Mathiesons, Ltd. }	
John Wright & Co., Ltd.	,, 6466.

Company Meetings

The General Meetings of the following companies for which dates have been given in previous issues of the "JOURNAL" have been postponed to dates to be announced later :

Commercial Gas Company.
South Metropolitan Gas Company.
South Suburban Gas Company.
Wandsworth and District Gas Company.

Railways (Demurrage Charges) Order

In the report of the Annual Meeting of the Conjoint Conference of Public Utility Associations in our issue of Feb. 26, p. 371, we incorrectly stated that action by the Conference had resulted in the cancellation of demurrage charges incurred up to the end of February, 1941. We regret that this was incorrect. The date should have read "February, 1940."

"Health and Fitness" Week at Redditch

With great thoroughness the Redditch Gas Company recently promoted a "Health and Fitness" week in the Company's Demonstration Hall. It consisted of health talks by Mr. Bowen Partington, and cookery demonstrations by Mrs. O. Vaun Roberts. The daily attendance in the afternoons was most satisfactory, and during the morning schools were visited, and over 1,000 children listened to food and diet talks. Mr. Partington also gave evening talks to members of the Home Guard, of the Youth Centre, and of the British Legion. Mr. Partington is a Home Office lecturer on A.R.P., and this form of talk added greatly to the popularity of the week, and the combined efforts were greatly appreciated.

The Warrington "Kitchen Front"

Much interest was shown in a Wartime Cookery Demonstration held recently at the showrooms of the Warrington Corporation Gas Department, when a visit was paid by Elsie and Doris Waters, the famous Radio and Stage Stars.

They were welcomed and introduced to the audience by Mr. A. Cook, Engineer and Manager, and after the demonstration they were entertained to tea and light refreshments at the showrooms.

They saw excellent demonstrations of cooking wartime dishes, including "Middleton Medley" and "Invasion Rolls." Miss Elsie Waters said that she and her sister were asked by the Ministry to help the food campaign via the Radio, and the "Kitchen Front" talks which they gave aroused such interest that more than 50,000 letters were received; as a result, 40,000 sets of recipes were sent out.

As an example of the effect of waste, Miss Doris Waters remarked that if everyone in the country wasted half-an-ounce of bread a day, the total figure would represen t250,000 tons of wheat, and that in turn would represent 30 ships to bring the wheat into the country.

They interspersed their more serious talk with asides in their stage characters of Gert and Daisy, and both paid warm tribute to the expertness displayed in the demonstrations.

INSTITUTION OF GAS ENGINEERS

Authors' Replies to Written Contributions—see last week's "JOURNAL," p. 421.

[Communication No. 2 of the Gas Research Board]

Mr. **A. T. Green**, in reply, wrote: We thank Mr. F. West for his very encouraging remarks on our work.

Professor Cobb has directed attention to a very important aspect of the action of alkali chloride vapour on firebrick refractory material. We were aware of the very interesting observations which he has recorded in the literature, and indeed referred to them in a general discussion on the action of alkalis on refractory materials,* and again, in the 25th Report of the Refractory Materials Joint Committee.† Our experiments point to the fact that the expansile and embrittling actions of alkali chlorides on refractory materials are consequent on the formation of alkali compounds at temperatures below their melting-points.

[Institution Communication No. 236]

Mr. **S. M. Milbourne**, in reply, wrote: I should like to take this opportunity of thanking Mr. Toogood for his comments. The design of gasholder cups is dependent upon a number of factors in addition to the choice of proportions of the cup and dip compartments. The principal variables that require to be taken into account when designing cup seals may be briefly summarized as follows:

(i) The proportions of the cup and dip compartments.
(ii) The pressures thrown by the various lifts.
(iii) The extent to which the cup and dip submerges in the tank water.
(iv) The variation in tank water levels resulting from the submergence or emergence of lifts.
(v) The allowances for minimum water seal in cups, water losses from cups and tank, and for the gasholder being out of level.

Mr. Toogood's suggestion for preventing the increase in pressure of the trapped gas in the dip by means of external equilibrium pipes attached to the dips of successive lifts was considered many years ago, but this system has not been generally adopted. In cases where the design of new cups and dips is being prepared there are no instances where such an arrangement would prove of greater practical value than a properly proportioned cup-and-dip section designed in accordance with the principles set forth in the Paper. So far as existing gasholders are concerned, equilibrium pipes fitted in the manner suggested could be employed in some instances as an alternative to drilling flooding holes in the cup plates, or to the other methods described for improving the performance of the hydraulic seals.

The dependence upon absolute gas-tightness and the satisfactory condition of comparatively long lengths of flexible piping is perhaps one of the main reasons why this form of apparatus is not looked upon with much favour.

Another method of relieving the pressure of the trapped gas in the dips of lifts approaching the uncupping position has been suggested by E. Young.* This consists of spring-loaded relief valves fitted to the dip of each lift. These valves are operated by means of a special trip gear attached to the side sheeting of the adjacent lift. When a lift has grounded and uncupping has commenced, the trip gear attached to the side sheeting of the descending lift depresses the valve spindle which releases the trapped gas to the atmosphere. This method is somewhat similar in its principle of operation to the method described by Mr. Toogood, except that a considerable amount of the trapped gas in the dip is liberated, and consequently the cup is flooded at a very early stage during the uncupping operation.

With a view to increasing the amount of hydraulic seal against "blowing" when a lift is uncupping, or preserving the oil film on the water in the cups, a number of special forms of syphon are now on the market. Some of these devices have not proved very satisfactory under actual working conditions. I am of the opinion that so far as new gasholders are concerned, it is preferable carefully to design the cup and dip sections so as to ensure that the hydraulic seals will operate satisfactorily without it being necessary to employ any special form of syphon or other comparatively complicated device.

In the case of existing holders in which it is found that the cups are defective in operation, the methods described in the Paper for overcoming the trouble are, I think, to be preferred to the use of special apparatus of a comparatively complicated nature.

* *Bull. B.R.R.A.*, 1933, **30**, 1.
† *Trans. Ins. Gas Eng.*, 1934–35, **84**, 360.

* "Oil for Gasholders," *Gas World*, 1933, **98**, 10.

CRUDE NAPHTHALENE AS FUEL FOR INTERNAL COMBUSTION ENGINES

PRELIMINARY EXPERIMENTS IN 1917

By J. H. WILLIS, Assoc.M.Inst.Mech.E.

[*We have recently discussed the use of naphthalene for motor transport and the work carried out in this direction during the last war. In particular we referred to the work undertaken in this country by Messrs. J. H. Willis and G. G. Willis. In the* "JOURNAL" *of Jan.* 8, 1918, *we published an article on the subject by Mr. Wilson; and in view of present conditions we reprint it, the Author having modified it very slightly.*—ED. "G.J."]

THE use of commercially pure naphthalene as a fuel for internal combustion engines was tried ten or twelve years ago, and I believe since, but as far as I am aware, without much success. Several different methods have been patented—notably of German and French origin. One of the plans proposed was to dissolve the naphthalene in one of the ordinary liquid fuels, such as benzole or petrol; but though these liquids will hold from 20 to 30% of naphthalene in solution, considerable trouble is experienced when the mixture is vaporized in a carburettor of the ordinary spray type, as the naphthalene is liable to separate at the spray and deposit in the choke-tube and induction pipe. In the latter case, one great difficulty is that the naphthalene must be quite devoid of any foreign matter, otherwise the jet or jets would rapidly become blocked up.

As far as I am able to ascertain from published reports, the quantity of naphthalene made (and sold as such) in this country, if used as fuel, would be equal to approximately 10 million gallons per annum. This is entirely ignoring the naphthalene that is sent away in creosote oil, such creosote oil often holding from 10 to 30% of naphthalene, some of which will settle-out in the cresote oil rail tanks, consequent upon a drop in temperature of the atmosphere. A good deal of naphthalene from this particular source might be recovered, if it were in sufficient demand.

Some crude naphthalene contains from 10 to 15% of the creosote oil from which it has been extracted, and this oil depresses the solidifying point from (say) about 79.5°C. down to 58° or 60°C. This latter would be a very poor crude indeed as compared with those naphthalenes we have examined, which were extracted in connexion with benzole and toluole recovery from coal gas. I should say, however, the worst crude naphthalenes which are sold at about £5 or £6 per ton might be whizzed in a centrifugal apparatus at a very little additional cost per ton, and made perfectly suitable for internal combustion engines, if used on the lines of the method which we adopted in the experiments described below. In fact, we are of the opinion that it is quite worth while experimenting on almost any standard type of heavy oil engine, with a view to seeing what percentage of creosote it would be safe to have in the crude naphthalene fuel. I feel sure that there is no need to use commercially pure naphthalene, which now commands abnormally high prices. It was the great difference in price between commercially pure naphthalene and crude naphthalene which was responsible for the evolution of a design for a vaporizer which could deal with the poorer quality of material.

The method which my partner (Lieut. G. G. Wilson) and I

"Therefore we stand, all of us, upon the watch-towers of history, and have offered to us the glory of making the supreme sacrifices and exertions needed by a cause which it may not be irreverent to call sublime".

The Prime Minister.

Help our cause by saving & lending

buy

3% SAVINGS BONDS (1955-1965)

2½% NATIONAL WAR BONDS (1946-1948)

3% DEFENCE BONDS

NATIONAL SAVINGS CERTIFICATES

or make a deposit in a

POST OFFICE SAVINGS BANK

or a **TRUSTEE SAVINGS BANK**

SPACE GIVEN BY THE WOODALL-DUCKHAM CO., EPSOM ROAD, GUILDFORD (TEL.: GUILDFORD 3301)

Issued by The National Savings Committee, London

IT'S THE NEEDLES THAT COUNT

It's the needles that make the difference so noticeable in the Newton Needle Steam Heated Gas Heater. This use of needles on the element is a planned and patented principle. No other system can ensure a better heat transfer or a more negligible back pressure.

But these are not the only advantages. The elements are of a special cast iron so that you have no corrosion problems. Less tubes are necessary and less space is occupied. In actual fact the saving of space over other types is anything up to 40%.

The Newton Needle Gas Heater is built to last, so that considering how low is its initial cost, it is indeed an economical installation.

Send today for your copy of an illustrated brochure describing the Newton Needle Steam Heated Gas Heater.

NEWTON NEEDLE
STEAM HEATED GAS HEATERS
NEWTON CHAMBERS & CO LTD THORNCLIFFE NR SHEFFIELD

have protected is free from all the objections which are inherent to the use of a spray-type carburettor, in that the molten naphthalene is not required to pass through any small diameter pipes or through a spray. Nor need we dissolve it in any other liquid fuel, though it is likely that it would be quite possible to use a mixture of benzole, petrol, and naphthalene, and probably even paraffin, or the like fairly heavy oil, with our method.

The Vaporizer Explained

The vaporizer used in the experiments is of the "surface" type; and its success with naphthalene alone as a fuel is influenced very much by (if not wholly dependent on) the fact that the vapour pressure of naphthalene rises very rapidly when the temperature rises above that required to melt it. We will allude to this later on. The experimental vaporizer is self-contained and was used both as a vaporizer and as the fuel storage-vessel. It consists of a rectangular exhaust jacketed vessel, built-up in thin steel plate, all joints being oxy-acetylene welded. The engine to which we fitted the apparatus is of about 10 b.h.p. and is one installed in a motor launch. It is a four-cylinder engine, running at about 1,000 revs. per min. under full load. The exhaust and inlet manifolds are, very conveniently, one above the other, so that the inlet gases are kept hot right up to the valves.

This apparatus was bolted close up to the main inlet to the induction manifold, and an exhaust jacketed tee piece was fitted. To the bottom arm of this tee the ordinary petrol carburettor was attached. From the exhaust pipe a small diameter pipe was connected, to lead a proportion of the exhaust gases round the jacketed chamber in which the naphthalene was to be melted. The back pressure thrown by the silencer at the extreme end of the exhaust pipe was sufficient to cause the difference of pressure required to force some of the exhaust gases round the vaporizer and out to the atmosphere, where any evidence of incomplete combustion would be easily perceived.

A division-plate was welded along the whole length of the exhaust jacket at the bottom of the chamber, for the purpose of carrying the exhaust gases to the far end of the vessel, whence they return, and finally have their exit *via* the jacketed tee and through an orifice.

Turning to the details of the vaporizing vessel, the proportion of the air which it was proposed to carburet approximately to saturation is drawn in by the suction of the engine down a vertical standpipe, past a butterfly valve, and so into the main induction manifold.

The uncarburetted air supply is taken through the existing petrol carburettor, the jet of which has been closed. The throttle-valve now acts as an air-control valve. This main supply of air is preferably warmed from the heat of the exhaust-pipe, so as to prevent the temperature of the whole mixture of explosive gas from dropping, and to keep it rather at an increased temperature, until it reaches the engine cylinders. A thermometer was fixed for the purpose of observing any variation in the temperature of the molten naphthalene.

The feed to the vessel was accomplished in the following manner: A diaphragm extends the full width of the apparatus, so that a chamber which is fitted with a loose lid is, when the naphthalene is molten, sealed off from the part of the vessel in which the carburation of the air takes place. To begin with, the chamber was simply filled right up with loose naphthalene crystals. The naphthalene used was a crude naphthalene, but of fairly good quality, and was extracted during the process of benzole and toluole recovery from coal gas, and did not contain a high percentage of creosote oil. As soon as the first naphthalene had melted, further quantities were filled into the chamber. The amount of heat—*i.e.*, the proportion of the exhaust gases necessary to maintain the required temperature of the chamber—was regulated by a cock.

The First Experiment

For the first experiment, the naphthalene vaporizer was filled up with fuel in the manner described, the engine started, and run for five or ten minutes on petrol. The melting-point of the naphthalene was rather under 79°C. (79.8° being the melting-point of pure naphthalene).

When the naphthalene in the exhaust jacketed chamber had reached a temperature of about 130°C., the petrol was turned off completely both at the cock and jet. At the same time, the butterfly valve G was opened; and by regulating the throttle on the petrol carburettor, which was now simply an air-controlling valve, the engine ran on crude naphthalene alone—the boat being under way. It was found that, by taking approximately 1-13th of the air through the carburettor, and saturating it with $C_{10}H_8$ vapour at a temperature of about 135°C., and mixing this with the other 12/13ths of uncarburetted air just before entering the inlet manifold, very satisfactory running of the engine was obtained. At first some difficulty was experienced in regulating the mixture of carburetted and secondary air, as unfortunately the butterfly valve was a very poor fit in the stand-pipe. However, this was overcome by opening the valve wide, and simply adjusting the air supply to suit.

We ran the engine under full load for an hour or so, and found it possible rapidly to regulate the secondary air so that the exhaust was absolutely clean. In fact, it was only for a few seconds that the mixture was rich enough to give out a black smoke. We had little difficulty with carburation, even when the temperature of the naphthalene varied between 130° and 160°C., and, furthermore, the level of the fuel in the chamber rose and fell as the naphthalene crystals were fed thereinto.

Owing to pressure of business we have been unable to carry out the experiments on this engine as far as we would have liked, as the apparatus was only working for a few hours in all; but there is every evidence that this method of surface carburetting is quite the most suitable for dealing with naphthalene in its crude state. The engine has since been dismantled for examination; and in spite of the fact that I purposely ran with a full mixture for some little time, there was comparatively little fouling in the cylinders. It is worthy of note, however, that what little deposit was found consisted of light flakes of lamp-black. When the mixture was sufficiently rich, this lamp-black was actually blown out of the exhaust pipe; but on re-adjusting the air supply, the exhaust became quite clear. The period for which the engine was run was not sufficiently long to prove conclusively that little or no fouling would occur. However, I think it is certainly advisable to keep the temperature of the water-jackets rather higher than is usual when using petrol as fuel.

It will be quite understood, I think, that this vaporizer is not supposed to be anything more than a purely experimental one, as it has been the intention all along to heat the main body of fuel (to melting-point only) on the main exhaust pipe itself. The vaporizing chamber would be directly connected thereto, and the liquid naphthalene would run from the main chamber into the vaporizing chamber, where its temperature would be increased to the degree necessary.

Naphthalene as a Fuel

It is very unlikely that it will ever be possible to use naphthalene as a fuel generally (in the place of petrol, paraffin, &c.), both because of the fact that there would not be a sufficient quantity available, and because undoubtedly it is very difficult to design the vaporizing apparatus for this fuel which would be easily fitted to almost any type of engine. Reverting to the question of the amount of this fuel available, it is probably a quantity equivalent to about 5 or 6 million gallons a year is now sold for use in the manufacture of fire-lighters. There is a great deal of variation in the quality of naphthalene extracted at different benzole recovery installations, and the melting-point varies between about 68° and 79°C. A test was made for the specific gravity of a sample of good quality crude naphthalene, with the following result:

	sp.gr.
Crude naphthalene crystals filled into cylinder without pressing	.468
,, ,, liquid and at 79.5°C.	1.03
,, ,, ,, ,, 85°C.	1.0
,, ,, ,, ,, 135°C.	0.956
,, ,, molten and re-cast, in solid (at 18.7°C.)	1.15

(Compared with water at 15.5°C.)

It will be seen from the above figures that, for the same gallonage (if one may use this term in connexion with a solid), the crude naphthalene crystals occupy a very much larger space than ordinary liquid fuels. But although this is certainly an objection, it is, in a measure, counter-balanced by the fact that crude naphthalene is, on the other hand, a much easier and safer material to store. It should be pointed out, however, that it is extremely easy to compress crude naphthalene into cakes or blocks without melting it, which meets the objection that might be advanced to the comparatively large space it occupies.

With regard to calorific value, it compares quite well with petrol and paraffin, the following being the figures:

	B.Th.U. per lb.
Paraffin, approximate	20,100
Petrol	18,700
Naphthalene (pure)	17,395

(*Continued on p. 474*)

TOWN GAS FOR SPECIAL ATMOSPHERES *

RESULTS OF AMERICAN INVESTIGATION

By C. R. CLINE and C. GEORGE SEGELER

American Gas Association Testing Laboratories

Engineer of Utilization, American Gas Association

(*Continued from p. 428*)

Continuing its policy of establishing basic combustion relationships, the American Gas Association through its Committee on Industrial Gas Research, Mr. F. J. Rutledge, Chairman, sponsored a series of studies to determine the effect of burning fuel gas with insufficient air for complete combustion. As a result of these studies, recently completed at the American Gas Association Testing Laboratories, it is now possible to predict accurately composition of flue gases (as determined by ordinary Orsat analysis) resulting from combustion of fuel gases with limited air supply.

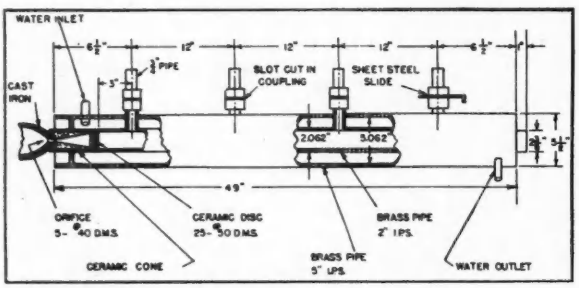
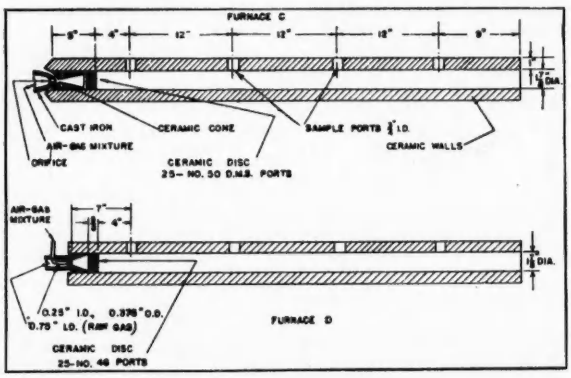


Figure 1 (above) Water Cooled Furnace B.
Figure 2 (right) Ceramic Furnaces C and D.



Three types of test furnaces were employed in these studies to simulate burner tunnels used on industrial furnaces. One, furnace B, consisted of a water-jacketed brass combustion tube approximately 2 in. I.D. and 47 in. long, as illustrated in fig. 1. A ceramic disc drilled with 25 No. 50 D.M.S. ports placed in the tube near one end served as a burner port and flame retainer. This arrangement served to keep flames spread more or less

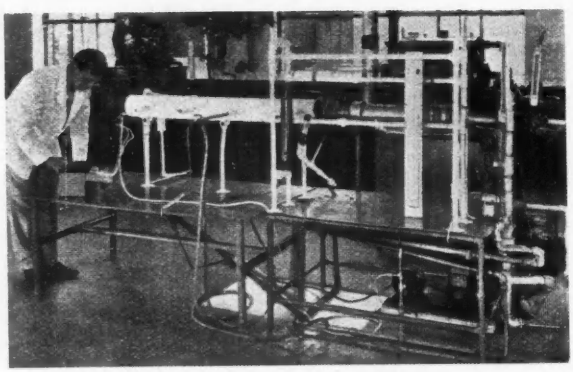


FIG. 3.—*Furnace B and supplementary equipment.*

uniformly over the cross-sectional area of the combustion tube. Thoroughly premixed air-gas mixtures were conveyed to this drilled burner disc through a ceramic tunnel diverging from a cast-iron nozzle. Four side sampling ports, starting 3 in. from the burner disc and spaced thereafter at 12-in. intervals along the combustion tube length, were provided to permit sampling and temperature measurement during the combustion process and subsequent cooling of flue products. A second test furnace, furnace C, consisted of a $1\frac{7}{8}$ in. I.D. refractory wall combustion tube 49 in. long with 1 in. thick walls. Side sampling ports, drilled burner disc, and premixing arrangements similar to those of furnace B were employed as shown by the upper sketch of fig. 2. The third test furnace, furnace D, was similar to furnace C, except that a specially designed combination premixing and diffusion type of burner was employed in place of the total premixing type. With this special burner, an aerated gas mixture was supplied through the centre opening of two concentric orifices while unburned gas was admitted through the larger outside orifice as shown by the lower sketch of fig. 2. The air-gas mixture passed from the orifice to the burner disc and burned on its outer face causing a hot spot at the centre. The unburned gas was consumed around the edges of this hot centre, its combustion being supported by diffusion of air from the centre air-gas stream. Test furnace D was employed only for a few special tests, and any references herein to a ceramic furnace apply to furnace C with the premixing burner, unless otherwise designated.

Natural gas having an average gross heating value of 1,108 B.Th.U. per cu.ft. and coke oven gas (mfd. gas A) having an average gross heating value of 544 B.Th.U. per cu.ft. were burned in the water-cooled furnace; while the same natural gas and a synthetic coke oven gas (mfd. gas B), made by pyrolysis of natural gas and having a gross heating value of 534 B.Th.U. per cu.ft., were burned in the ceramic-walled furnaces C and D.

In operating these test furnaces, predetermined fuel inputs were burned with various proportions of air. Test furnaces were operated under each condition for a sufficient length of time to establish thermal equilibrium. Thereupon, samples of flue gases were taken and temperatures were measured at each sampling port. Suitable equipment was employed to assure accurate sampling and freedom from subsequent contamination of flue gases. Analyses of the flue gas samples were made with a modified Orsat type of analytical apparatus. Flue gas temperatures were measured by high velocity thermocouple method, the chromel-alumel and platinum-platinum rhodium couples employed being checked at frequent intervals to avoid errors from possible contamination of the wires by reducing gases. A general view of sampling equipment and high velocity thermocouple being used with test furnace B is shown in fig. 3.

Part 2

Effect of Quantity of Air Supplied on Products of Combustion

When burning a fuel gas in any given test furnace, material changes in composition of flue products were found to occur as the amount of air premixed with fuel gas prior to combustion was varied. This effect of aeration,* or amount of air supplied for combustion, on concentrations† of various flue gas constituents produced by combustion with limited air supply is shown in figs. 4, 5, and 6. Although small variations in concentration of different flue gas constituents from values shown in figs. 4, 5, and 6 were observed in many instances, average values are well represented by curves of these figures.

(*a*) **Results with Natural Gas:** When burning natural gas

* Paper presented before the American Chemical Society.

* Throughout this paper, air supplied for combustion will be expressed as a percentage of that theoretically required for complete combustion, or more simply, expressed as "per cent. aeration." Such a term simplified comparison of results obtained with fuel gases having widely different combustion air requirements and avoids confusion due to minor changes in combustion air requirements as heating value of each fuel gas varied within limits from day to day.

† Concentrations of the various flue gas constituents, including water vapour formed by combustion, determined in this study, are expressed as percentages of the total dry flue products, this basis being the one commonly employed in Orsat analytical work.

PIONEERING BY PARKINSON

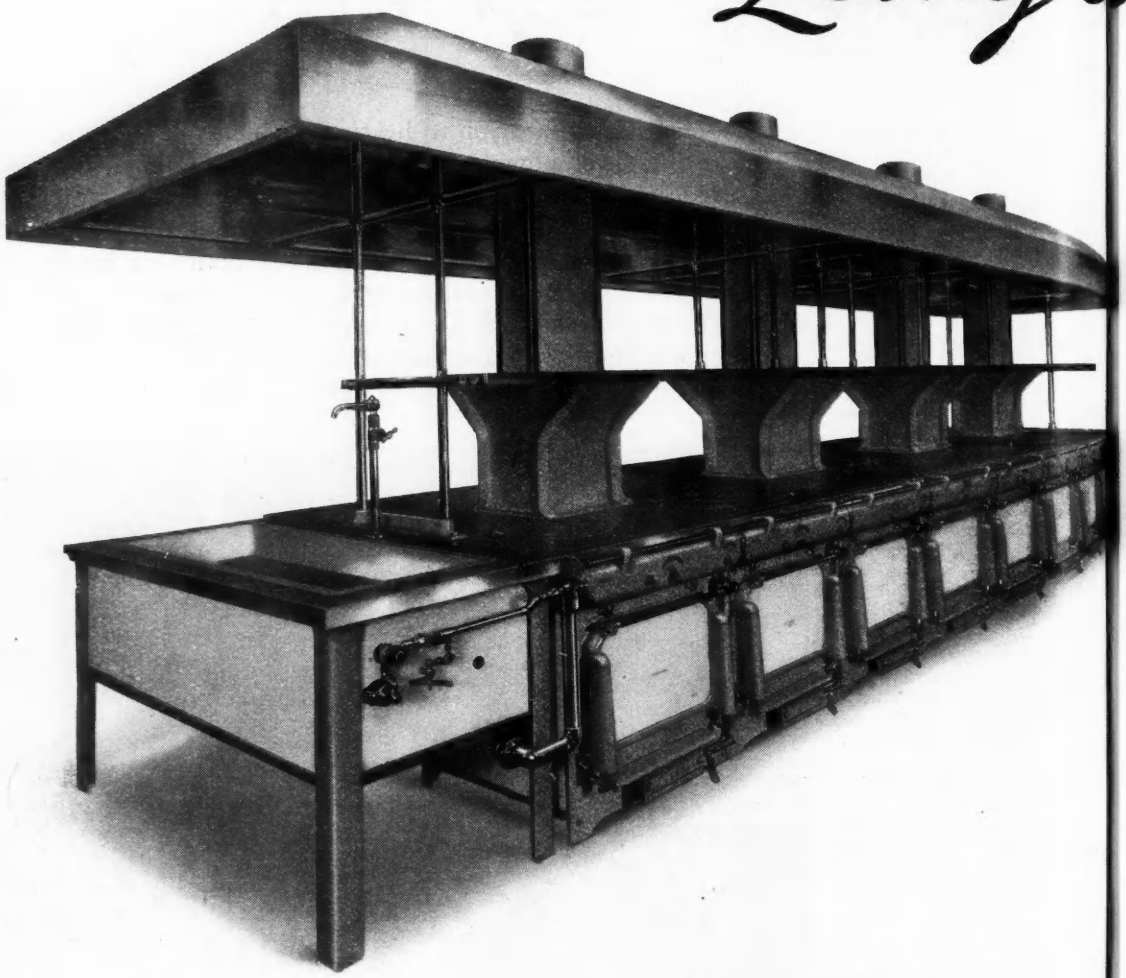
The development of Gas Fire design & efficiency....

Scientific application to heating problems of the home has resulted in the development of Parkinson Fires designed to meet the heat requirements of different rooms. The metallic radiant for portable gas fires was pioneered by Parkinson, and the introduction of gas appliances utilising the directional reflection of heat proved a great success. Every possible service to the Industry will continue to be given, and when Britain has emerged triumphant from its epic struggle in the cause of Freedom, then with renewed vigour will the Parkinson organisation prosecute its policy of progress.

PARKINSON MODERN GAS FIRES

THE PARKINSON STOVE COMPANY LTD., BIRMINGHAM 9. London Showrooms: TERMINAL HOUSE, GROSVENOR GARDENS, S.W.1

Larges



A battery of Grosvenor Ranges. Can be supplied in any number of units as required.

Radiation Ltd.

gescale Equipment

GAS Undertakings receiving enquiries from those in charge of catering arrangements for evacuated persons, transferred office and factory staffs, etc., may obtain expert assistance on all matters affecting large and medium-large cooking equipment, on applying to Radiation Limited.

Complete cooking apparatus and accessories for Canteens, Hospitals, Barracks, Evacuation Camps, etc., supplied.

A.R.P. boilers of fully approved design ; water heaters and decontamination appliances suitable for all situations.

The facilities offered by Radiation Limited are the outcome of wide experience in the design and production of large scale equipment in use all over the world.

Radiation

APPARATUS FOR LARGE-SCALE COOKING AND SERVING OF FOOD

fully experienced in the layout and furnishing of industrial kitchens, MAIN *specialists in cooking apparatus have, since National preparedness became vital, planned and equipped some of the most extensive installations in the country*

All manner of large-scale kitchen equipment comes within their scope, and Gas Officials with any catering problems, large or small, are gladly offered the benefit of an extensive knowledge of the subject.

MAIN

R. & A. MAIN LIMITED, LONDON AND FALKIRK

with an air supply equal to that theoretically required for complete combustion (100% aeration), concentrations of carbon dioxide and water vapour closely approached ultimate limits as indicated on fig. 4. Deviation in concentrations of these gases below their ultimate limits is adequately accounted for by presence of small quantities of oxygen, carbon monoxide, and hydrogen in the flue products at this aeration. Decreasing air supplied for combustion resulted in decreasing concentrations of CO_2 and H_2O and proportional increases in CO and H_2 concentrations in flue products.

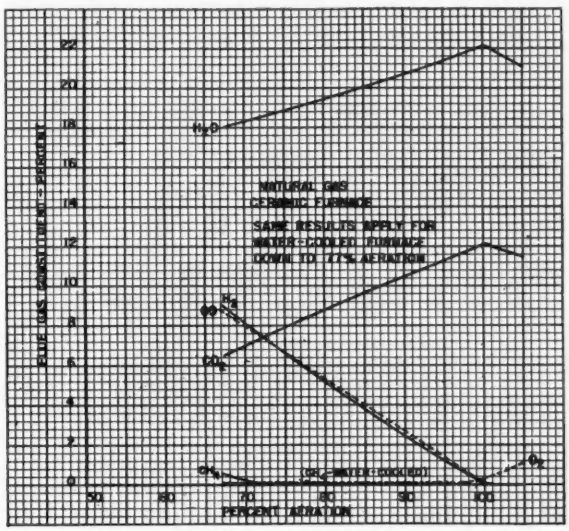


FIG. 4.—*Flue Products Resulting from Combustion of Natural Gas with Limited Air Supply.*

When natural gas was burned in the water-cooled furnace at the same aeration as in the ceramic furnace, no noticeable change in concentrations of CO_2, O_2, CO, H_2, or H_2O in products of combustion were noted. These results justify the conclusion that wall temperatures have no appreciable effect on the amount of these flue gas constituents formed at any given degree of aeration.

Although concentrations of O_2 and CH_4 in the products of combustion were small at all aerations, change in concentration of these constituents, as air supplied for combustion was decreased from 100% aeration, had certain peculiarities worthy of mention. Oxygen concentration in flue products reached a minimum value of 0.05% when air supplied for combustion was decreased to approximately 95%, but increased slightly as aeration was further decreased. Actual presence of small concentrations of O_2 in the flue products at all aerations was indicated by checking results obtained in Orsat analytical equipment using potassium pyrogallate absorbing solution with the more sensitive "manganese hydroxide titration method." It is likely that these small amounts of free oxygen in flue products were in equilibrium with the other flue gas constituents, and that even if all oxygen were removed by some means, more would be formed at elevated temperatures by dissociation of CO_2 or H_2O.

Methane was found to occur in traces only or to be entirely absent from flue products of natural gas for combustion air supplies ranging downward from 100 to 80% aeration. As the combustible limit at lower aerations was approached and the flames became unsteady, methane content of the flue gases increased rapidly and reached its maximum concentration of approximately 0.5% at the lowest aeration supporting combustion. Conditions such as heat loss characteristics of combustion tube and type of burner employed influenced the minimum air supply which would support combustion. For this reason, aeration could be decreased to a lower value without producing appreciable quantities of methane in the flue products when employing the ceramic furnace than for the water-cooled one. No illuminants (C_2H_4, C_6H_6, &c.) or ethane (C_2H_6) were found in the products of combustion of natural gas at any aeration which would support combustion.

(*b*) **Results with Manufactured Gas:** Results obtained by combustion of manufactured gas A with limited air supply in the water-cooled test furnace are indicated in fig. 5. As in the case of natural gas combustion, when carbon dioxide and water vapour concentrations approached ultimate values of 100% aeration, only small amounts of hydrogen, carbon monoxide, and oxygen appeared in the products of combustion. As air supplied for combustion was decreased, amounts of carbon dioxide and water vapour in the flue products decreased while amounts of carbon monoxide and hydrogen increased, these concentration changes being proportional to aeration decreases. Although concentration of free oxygen in flue products again reached a minimum at approximately 95% aeration, minimum values were 0.15% O_2 for this gas, and concentrations gradually increased as combustion air was decreased, 0.20% O_2 being noted at 70% aeration.

Only small concentrations of hydrocarbons were found in flue products of manufactured gas A for aerations above 75 or 80%. As combustion air was decreased below this point, however, methane concentration became increasingly greater and reached approximately 1.0% at the lowest aeration supporting combustion. Similarly, illuminant content in flue products increased from zero to 0.5% when aeration was decreased from 75% to the lowest figure supporting combustion. It should be noted that at 58% aeration, which was the lowest aeration attainable in the water-cooled furnace, methane concentrations in the flue products represented only about one-tenth of that originally in the fuel, while approximately half of the illuminants in the fuel appeared in the flue products. These results lead to the inference that methane is more readily burned or cracked than illuminants under conditions of minimum aeration. Absence of ethane in flue products at any aeration demonstrates that this constituent is more readily combustible than other hydrocarbons in the fuel gas.

Manufactured gas B was found generally similar to the other two test gases in so far as effect of aeration on concentrations of carbon dioxide, water vapour, carbon monoxide, and hydrogen in flue gases was concerned. Relative concentrations of the different flue gas constituents found by combustion of this gas with varying amounts of air are shown in fig. 6. Changes in concentrations of oxygen were found to be similar to those noted for natural gas, minimum concentrations of 0.05% appearing in the flue products at 95% and slowly increasing as aeration was further decreased, but never exceeding 0.10% O_2. As

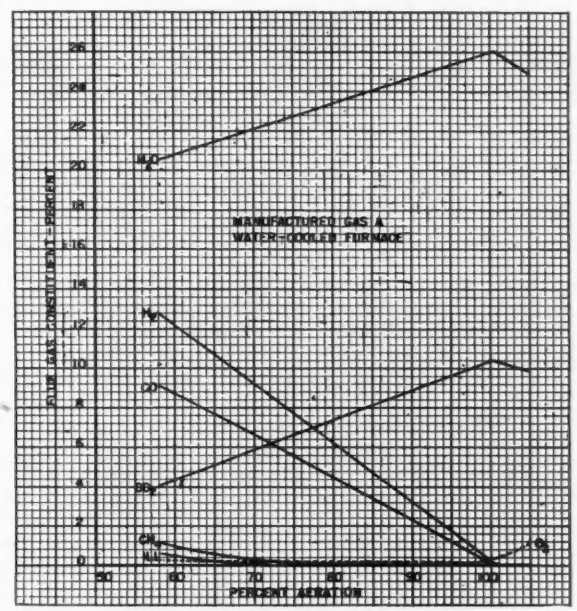


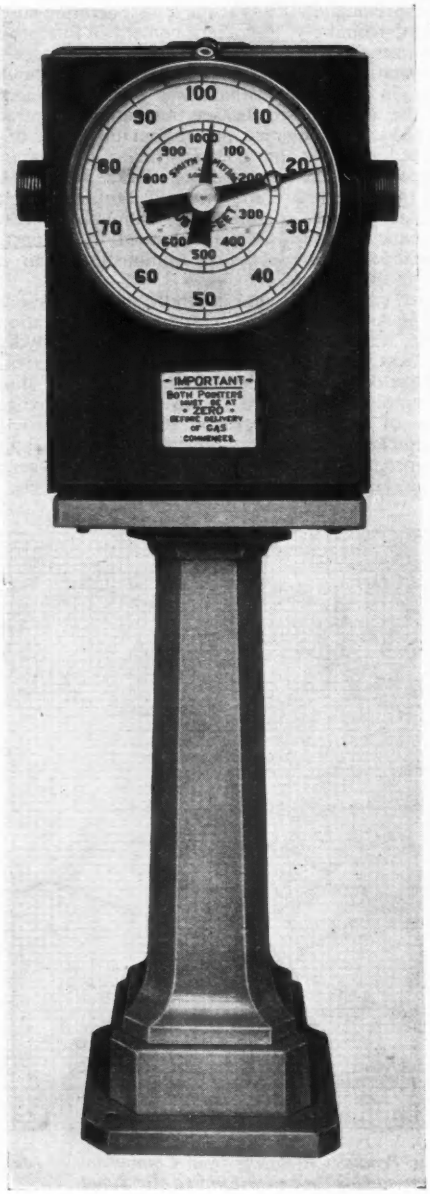
FIG. 5.—*Flue Products Resulting from Combustion of Manufactured Gas "A" with Limited Air Supply.*

pointed out for the other two gases, methane content of flue products remained relatively small as air supplied for combustion was decreased until a figure was approached at which combustion was not self-supporting. Maximum methane concentration observed at the lowest aeration was 0.8%.

Effect of Fuel Gas Composition on Products of Combustion

Although combustion characteristics of the synthetic coke oven gas (gas B) were similar to the regular coke oven gas

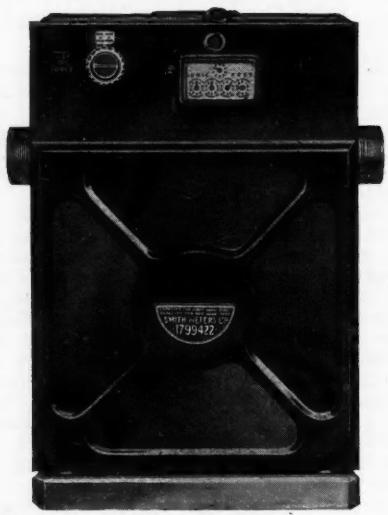
METERS FOR TRANSPORT
GAS FUELLING



A SMITH PRODUCTION

REGISTERS VOLUME TO INFLATE CONTAINER IN MINIMUM TIME AT DISTRICT PRESSURE

BACK VIEW



MOUNTED UPON SOLID REINFORCED CONCRETE BASE SECURELY BOLTED DOWN

SPECIFICATION

1. **CASING—18 gauge**
2. **RADIAL VALVES**
3. **GEAR BOX**
4. **INDEX at back. Total cons., 10 million c. ft.**
5. **DIAL. 15 inch with ¼ plate glass**
6. **OILING TO 4 POINTS**
7. **POINTERS. Set to zero in one operation**
8. **PAINTED. Two coats lead priming and finishing. Coat to order.**

SMITH METERS LIMITED

Head Office and Works :

186, KENNINGTON PARK RD., LONDON, S.E.11. *Tel. : RELIANCE 2447-8-9. 'Grams : Smieters, Lamb, London.*

3-4, EAST PARADE, LEEDS, 1 Telephone: LEEDS 23726

(gas A), in many respects the composition of flue products of this gas, which was made by pyrolysis of natural gas, more closely resembled those of natural gas. Further analysis of the data disclosed that although the kind of constituents in the fuel gas was responsible for its combustion characteristics, total amount of carbon and hydrogen, either free or combined, in the fuel gas has the greater influence on volume of each flue gas constituent formed. This is illustrated in fig. 7, which shows that for each aeration, proportional division of carbon of each fuel gas between carbon monoxide and carbon dioxide was very

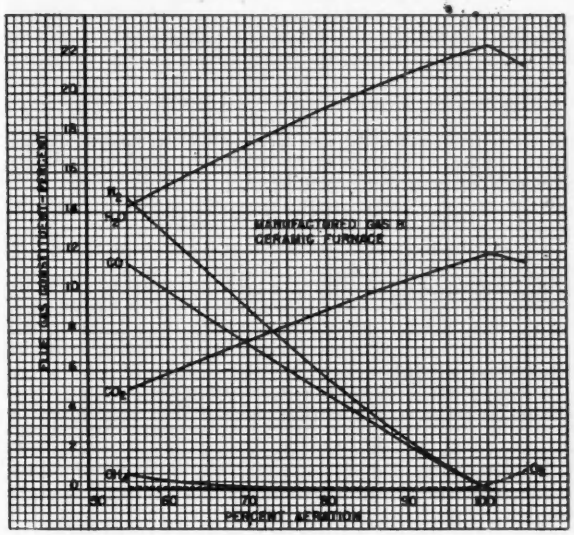


FIG. 6.—*Flue Products Resulting from Combustion of Manufactured Gas "B" with Limited Air Supply.*

nearly the same. For example, at 90% aeration, total carbon of natural gas was distributed 20% to carbon monoxide and 80% to carbon dioxide. For manufactured gases A and B, 20 and 18%, respectively, of total carbon appeared in flue products as carbon monoxide and 80 and 82% as carbon dioxide. At 70% aeration, 52, 51, and 50% of total carbon in natural gas, manufactured gas A, and manufactured gas B, respectively, appeared in flue gases as carbon monoxide. Amount of carbon found in flue products as carbon dioxide at this aeration was 46, 46, and 48%, respectively, of total carbon in the three fuel gases. At this aeration, the small amount of total carbon not accounted for by that in carbon dioxide and carbon monoxide was contained in hydrocarbons, concentrations of which are not shown in fig. 7.

Division of total hydrogen in fuel gases between free hydrogen and water vapour in flue products was similarly consistent as may be seen by examining fig. 7. Use of these relationships should provide a simple means of estimating composition of flue products from any fuel gas within limits of composition of those employed in these studies when burned with limited air supply.

Variation of Flue Products with Temperature

Variations in composition of flue products with change in flue gas temperature were found to be small under the conditions of this investigation. Although no change in concentration of any one flue gas constituent greater than ½ of 1% of the total dry flue products was noted for any temperature change imposed, it does not follow that temperature may be considered negligible for all industrial applications. Flue products were cooled so rapidly in the test furnaces, from over 3,000°F. to less than 1,800°F. in approximately 0.2 sec., that the element of time may have prevented greater composition change. Moreover, combustion tubes employed were constructed of brass and ceramic materials, and it is quite possible that presence of other materials, such as iron oxides, might catalyze reactions causing greater flue gas composition changes.

The only flue gas constituents showing noticeable concentration change with decrease in temperature were CO_2, CO, H_2, and H_2O, and change in concentrations of these components was not observed below approximately 1,600°F. At higher temperatures, concentrations of CO_2 and H_2 in flue products generally increased and those of CO and H_2O usually decreased as temperature of flue products was decreased. These composition changes apparently were influenced by amount of temperature decrease, original temperature level, and original amounts of each flue gas constituent. Temperature decreases from approximately 2,000° to 1,600°F. produced little effect on flue gas composition, changes in concentration of CO_2, CO, H_2, or H_2O being not more than 0.1 or 0.2% of the total dry flue products. Concentration of any one of these flue gas constituents usually did not change more than 0.3% for temperature decreases in the temperature range of 3,000°F. to 2,000°F., although a few instances were noted where H_2 and CO concentrations changed as much as 0.5% for such temperature decreases.

As previously noted, furnace wall temperature had no noticeable effect on flue gas composition other than its influence on minimum aeration supporting combustion, which was responsible for appreciable quantities of unburned methane in flue products at aerations approaching this combustible limit.

Effect of Furnace Design on Combustion

It has been pointed out in the preceding discussion that each test gas could be burned in either test furnace at any degree of aeration down to 80% without producing more than traces of unburned hydrocarbons in the flue gases. As aeration was decreased below this figure, a point was reached for each gas and each furnace where heat developed by combustion was lost to the furnace walls rapidly enough for the gas temperature to be only a little above the ignition temperature of the air-fuel gas mixture. As the lowest aeration supporting combustion was approached, less and less heat was available to crack the remaining hydrocarbons in the fuel; and methane concentrations in the flue products became increasingly larger, until that aeration was reached where the heat generated would not sustain combustion. The effect of combustion chamber material on the combustibility of natural gas is shown in fig. 8.

From this it may be seen that heat loss characteristics of the combustion chamber had an important effect on the minimum aeration which will support combustion of a given fuel gas. Although only two materials of construction were used in this investigation, the ceramic combustion tubes proved to be much better than the water-cooled metal tubes for combustion at

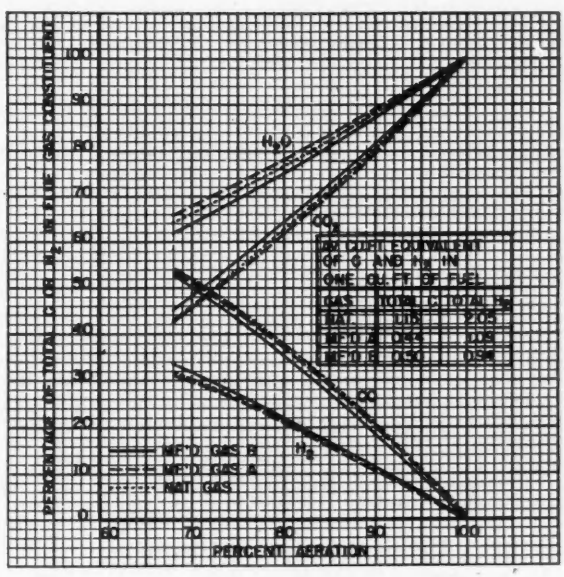


FIG. 7.—*Percentage of Total Carbon and of Total Hydrogen in the Three Test Gases found in the Flue Constituents at Various Aerations.*

very low aerations; and results indicated that combustion tubes having better insulation could be employed to burn gas at still lower aerations. For example, the minimum air supply which would support combustion of natural gas in the ceramic and water-cooled experimental furnaces was 67 and 77% respectively of the total air required for theoretically complete combustion. Similarly, manufactured gases could not be burned below 53 and 58% aeration in the ceramic and water-cooled test furnaces respectively.

Although not investigated in this study, it seems reasonable from the foregoing to assume that for production of larger quantities of CO and H_2, lower aeration mixtures could be burned than attained in this study by external heating of the combustion chamber walls or by use of preheated air. Also, it is not unlikely that cross sectional areas different from those employed in this investigation might permit combustion at lower aerations.

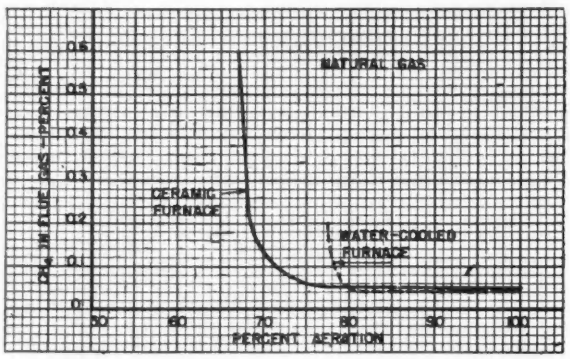


FIG. 8.—*Methane in the Flue Products Resulting from Combustion of Natural Gas with Limited Air Supply.*

Effect of Burner Design on Combustion

In the early stages of these studies it was found desirable to employ drilled port ceramic discs of the type illustrated in figs. 1 and 2. Single port burners were found to promote flame fronts having a large horizontal component as air supply was reduced toward lower limits of combustion. Combustion on a long horizontal flame front usually resulted in a puff of flame and contamination of air-fuel gas mixture with flue products, leading to premature extinction of flames. Multiple-drilled ports in ceramic burner discs overcame such characteristics by providing an essentially vertical flame front, as well as providing a more uniform distribution of flow of gaseous mixtures over the cross-section of the combustion tubes. It was also noted that ceramic material placed around or close to the burner ports, which became incandescent by its proximity, was very helpful in keeping the flame burning smoothly at very low aerations.

Still further improvement in combustibility was made by subsequent changes in burner design. A double port arrangement was substituted for the single port through which the combustible mixture was transmitted to the ceramic burner disc. A mixture containing approximately 100% of the air theoretically required for complete combustion was supplied through a central port, while raw gas was admitted through an annular port surrounding this as shown in the lower sketch of fig. 2. Although some mixing undoubtedly occurred prior to combustion, a relatively air-rich mixture was maintained at the centre of the ceramic burner disc and a gas-rich mixture at its extremities.

The air-rich mixture provided a high temperature ignition source, while absorption of heat by the outer layers reduced heat losses in proportion to average temperatures. Under these conditions natural gas was found combustible with 62% aeration, or at 5% lower aeration than with the total premixing type of burner illustrated in the upper sketch of fig. 2. These results indicate that other burner designs may be developed which would utilize the heat generated by combustion to greater advantage in maintaining combustion at very low aerations.

Future of Special Atmospheres

In the preceding section of this paper, data have been presented outlining the results of the investigation of the limits of partial combustion. It is worth remembering that these limits are not the limits of special atmospheres in general because of modifications which can be produced by other methods such as cracking, removal of unwanted gases, catalysis, and so on. Nevertheless, the results of the American Gas Association's current researches appear useful because they have charted a previously unexplored area in our knowledge of combustion; they may be summarized as follows:

1. For a given fuel gas, composition of flue products may be varied over a wide range by limiting the amount of air supplied for combustion.

2. Other variables such as flue gas temperature, input rate, or combustion chamber wall temperature were found to have a relatively minor effect on concentrations of flue gas constituents formed at any given degree of aeration.

3. Oxygen may be practically eliminated from flue gases by reducing the air supplied for combustion to 95% or less of that theoretically required for complete combustion.

4. Fuel gas can be burned at aerations close to the lower combustible limit without more than traces of unburned hydrocarbons appearing in the flue products.

5. Flue gas composition which will be produced by combustion of a given fuel gas at a given aeration may be estimated from the fuel gas analysis, since it was found that amounts of carbon dioxide, carbon monoxide, hydrogen, and water vapour formed by combustion were a function of the amounts of total carbon and of total hydrogen (either free or combined) in the fuel gas.

6. Where it is desirable to burn fuel gas with least possible air supply to produce maximum quantities of reducing gases, carbon monoxide and hydrogen, careful attention should be given to both heat loss characteristics of combustion tubes or chambers and to the design of burner employed.

A Hint at Things to Come

Throughout this Paper, the use of prepared atmospheres in metal treating has been stressed largely because this has been the largest field in which they have been applied, but it has by no means been the only one. Space will not permit more than a hint at the things to come, although so useful a tool is bound to expand as manufacturers become more familiar with its possibilities.

The metallurgical industries are only beginning to apply these methods for the reduction of ores. Some of the typical examples are the decarburizing of pig iron to make steel by the R. K. process, recently invented by a Swedish Count. At least two and possibly three mining companies are experimenting with the direct reduction of iron ore with special atmospheres made from gas, which, if successful, will be truly revolutionary in character.

In the chemical field, it may be wrong to claim hydrogenation as an application of special atmospheres, but it won't hurt to remind ourselves that the special atmosphere is an excellent source of high hydrogen concentrations. Chemical manufacturers handling inflammable liquids have used inert atmospheres for fire protection and for purging. Theoretically, boiler flue gases from any fuel might be applied for this work, but practice has shown the desirability of using controllable, independent special atmosphere generation in order to avoid the hazard of introducing air, which may happen so easily in the case of boiler gases. In the related paint and varnish field applications of inert atmospheres for agitating linseed oil and blanketing it against fire hazards are growing rapidly.

Because the results of applied special atmospheres improve the quality and finish in so many products, there is certain to be a definite change in specification for many different classes of merchandise. Not only is it possible to make better looking products, but the bright finishes and hard surfaces make new applications practical. In no field is this likely to become of greater significance than in our programme of National Defence. Twenty years ago during the first World War, the demand for certain munitions almost exceeded our ability to turn them out. It was a mechanical development—the continuous conveyor oven—which received its start in those years and which proved to be one of the vital factors in doing the job.

CRUDE NAPHTHALENE.

(*Continued from p. 465*)

In view of the very great shortage of fuel in this country, it is astonishing to find that any proportion whatever of this commodity is allowed to be employed for the purpose of making fire-lighters, when it might be put to a very much more important use as a fuel for internal combustion engines—not the least of its advantages being that its cost is, at the present time, about one-half that of paraffin.

I am given to understand that the official view taken is that, though the possibility of using naphthalene is known, they think the supply of the commodity would be insufficient if a considerable demand were to arise for use in motors; and the present advantage of cheapness would be speedily lost; under present conditions of restrictions and of control prices, it is very hard to see how this point could arise.

In conclusion I am very glad to acknowledge the value of the discussions which I have had with Mr. T. F. E. Rhead, M.Sc., towards the latter part of the experiments, when thermostatic control was decided to be an essential factor to future development.

PATENTS

Prepayment Mechanism

Alder & Mackay, Ltd., and A. Peet have been granted a patent (No. 530,511; application date, May 6, 1939) relating to prepayment mechanism for gas meters. The object is to provide improvements from the following aspects:

(1) Security of valve closing even in the presence of grit;

(2) Simplicity of mechanism having regard to the functions it is called on to perform.

The invention consists in prepayment mechanism including a cylinder with a suitable circumferential slot forming a cam-like member driven from the combined prepayment and measuring back mechanisms and coacting with a pin or the like for effecting valve opening and closing rapidly at appropriate times while substantially controlling the valve and not leaving it free at other times.

The invention further consists in a prepayment mechanism as described in the preceding paragraph including a valve closing arrangement comprising a long lever co-operating with the valve lever or the like and with the cam of the preceding item, in such a manner that although it is normally in constant contact with the valve closing lever, except for such clearance as may be desired, the actual opening and closing of the valve only corresponds to a short part of the total movement of the mechanism operating the cam.

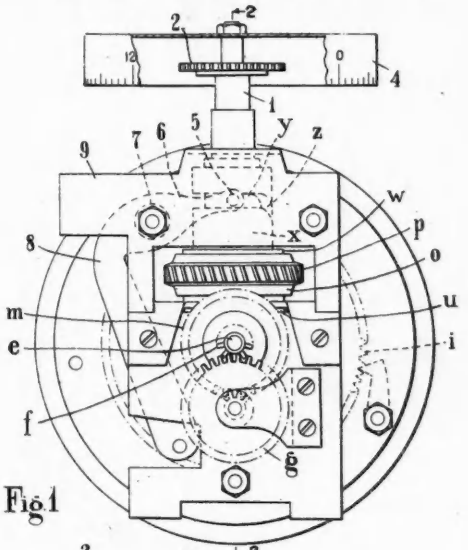


Fig. 1

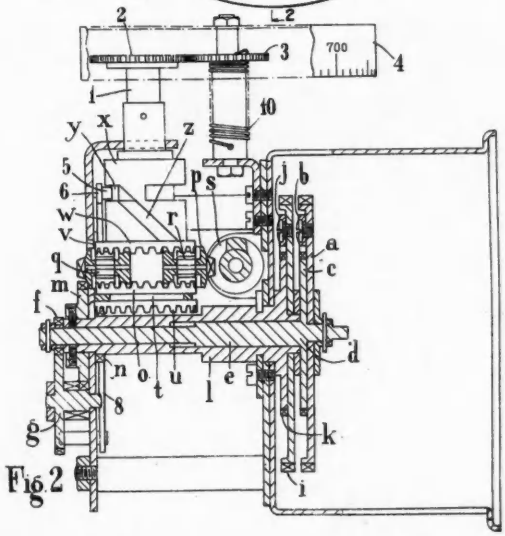


Fig. 2

Fig. 1 is an end elevation viewed from the back of the mechanism looking in a direction towards the front of the meter. Fig. 2 is a sectional elevation on the line 2—2 of Fig. 1 looking in the direction of the arrows.

A penny measuring out wheel *a* is connected by a pawl *b* to a ratchet wheel *c* adjacent thereto mounted on the end *d* of a shaft *e* extending through the mechanism to the penny pinion *f* of a coin ratio gear *g* at the opposite end. A shilling quantity wheel *i* is connected by a pawl *j* with a ratchet wheel *k* adjacent thereto carried on a sleeve *l* extending across the prepayment mechanism and bearing two pinions *m*, *n*, the former *m* of which is in proximity to the penny pinion *f* and may be called the shilling pinion. The penny pinion *f* and the shilling pinion *m* are connected through appropriate gear wheels of the coin ratio gear *g*. The other pinion *n* is connected to a differential mechanism *o*. The differential mechanism *o* comprises an externally toothed cage or container *p* with internal pinions, *q*, *r* mounted at right angles to the whole. The teeth of the externally toothed cage or container *p* engage with the driving back worm or the like *s* of the meter mechanism. The container *p* carries on one face *t* a prepayment crown wheel *u* which engages with the pinion *n*. On the opposite face *v* it carries a driving back crown wheel *w* on which is mounted a cylindrical block *x* in which is cut a groove *y* leading from which is a slot forming a cam groove *z*. The spindle 1 of this assembly carries a prepayment indicator driving pinion 2 which engages a similar pinion 3 on the centre or pivot of a prepayment indicating disc or drum 4 of such a size that it covers this combined gear 2—3. The cam slot *z* and its associated groove *y* receive a pin 5 on the end of one arm 6, a pivoted rocker shaft 7 carrying a long rocker shaft arm 8, the end of which arm 8 engages the valve lever of the meter.

The method of working is as follows:

Upon the penny quantity wheel *a* being turned by a coin in the coin carrier, not shown, the penny quantity wheel pawl *b* engages in a tooth of the associated ratchet wheel *c* and transmits rotation of the penny pinion *f* through the associated parts of the coin ratio gear *g* and the central sleeve *l* to the prepayment crown wheel *u* of the differential mechanism. During the rotation of the crown wheel *u* the differential container *p* may be regarded as stationary but the driving back crown wheel *w* rotates with the associated cylindrical block *x* and prepayment indicating pinions 2—3 and drum 4. For a large part of the time during prepayment or meter operation the pin 5 associated with the rocker shaft 6 moves in the groove *y* and not in the cam slot *z* but it enters the cam slot *z* towards the end of the travel either in connexion with the opening or the closing of the valve through the arm 8. When in the cam slot *z* the rotation of the driving back crown wheel *w* rotates the rocker shaft arm 8 and the valve lever is appropriately moved.

The shilling measuring out wheel *i* being turned by a coin in the coin carrier, the pawl *j* on that wheel engages the teeth of the associated ratchet wheel *k*, rotating the sleeve *l* on which it is mounted and the gears of the coin ratio gear *g* carried thereon together with the penny gear train and the penny ratchet wheel *c*. The prepayment crown wheel *u*, the cylindrical block *x* with groove *y* and cam slot *z*, rocker shaft 7, rocker shaft arm 8, and prepayment indicating gears 2—3 are moved to an appropriate extent as with the penny operation.

Upon the meter working back the meter worm *s* rotates the externally toothed cage or container *p* and as the prepayment mechanism restrains the prepayment crown wheel *u* from rotating, the driving back crown wheel *w* rotates the opposite way to the direction of rotation corresponding to prepayment and the cylindrical block *x* with groove *y* and cam slot *z*, rocker shaft 7, and rocker shaft arm 8 are likewise appropriately moved together with the valve lever, the prepayment indicating gears 2—3 and the prepayment disc 4.

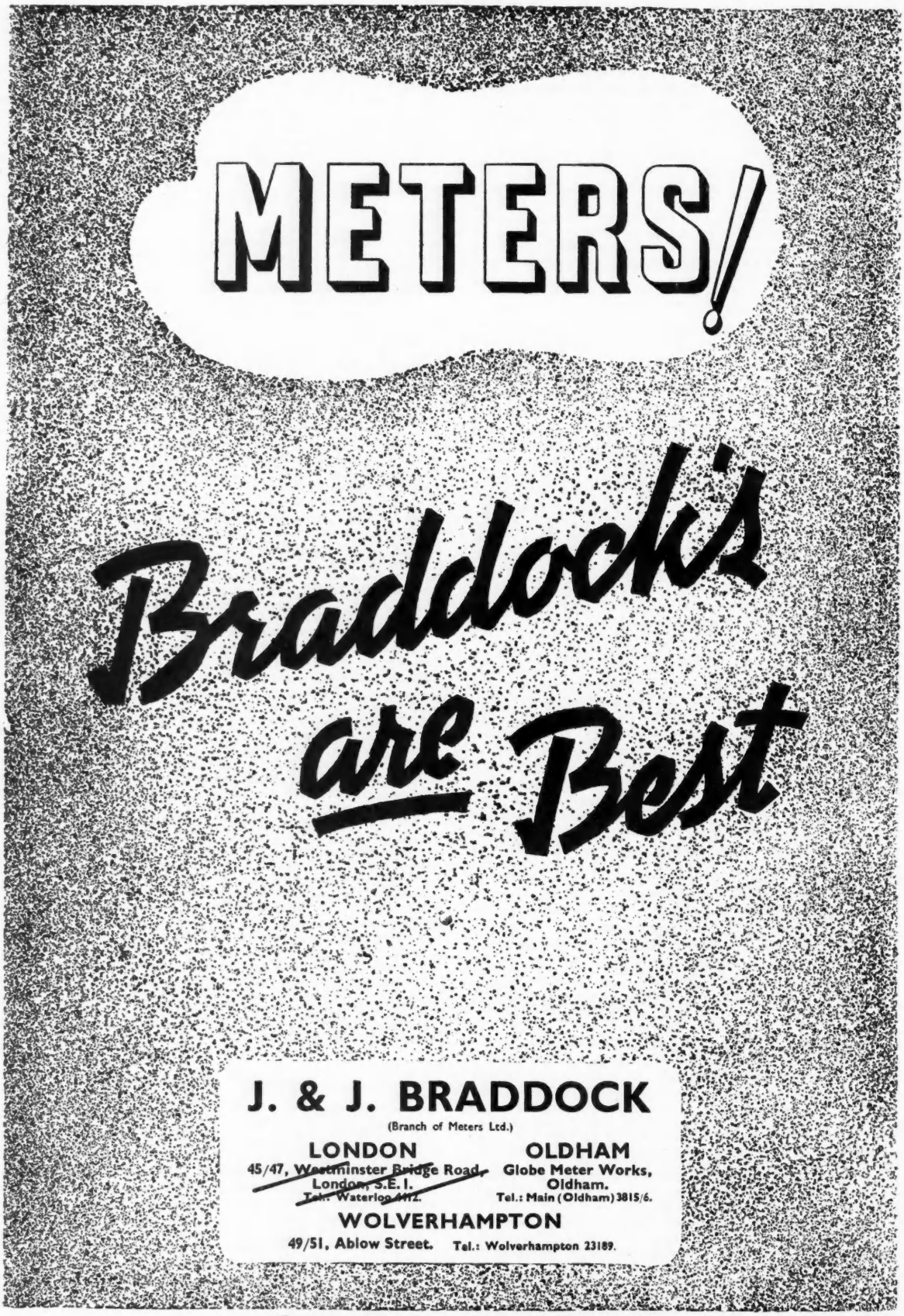
Modifications may be made in the form given by way of example above. For instance the groove *y* of the cylindrical block *x* may be a continuous groove from which the slot forming the cam groove *z* leads. The rocker shaft arm 8 may be placed outside the end plate 9 of the mechanism instead of inside as illustrated. The gears 2—3 may be of any desired ratio, for instance 1 : 1, and a coiled spring 10 may be placed round the spindle of the gear 3.

With such a mechanism the valve tends to be well held on its seat even should there be grit disposed between the valve and the seating. In part at least this appears to be due to the long rocker shaft arm and also to the pawls on the quantity wheels engaging the associated ratchet wheels and thereby, as it were, building-up pressure or resistance which is communicated to the valve, on any tendency of that valve to rotate, as is sometimes found to be the case. This tendency to rotate apart from these ratchet wheels would tend to move the quantity wheels and perhaps allow the passage of uncharged gas. Both the aforesaid pawls must be lifted together to return the quantity wheels to zero by hand from the front of the meter. It is preferred that the main prepayment shaft and sleeve shall be horizontal and the differential mechanism arranged on a vertical axis about halfway between the ends of that shaft and the sleeve.

Muffle Furnaces

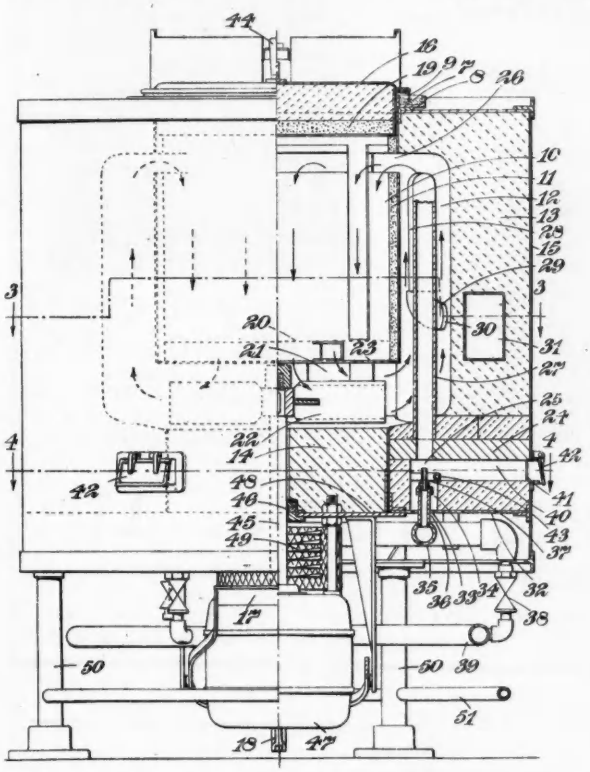
Uniform heating of a muffle furnace is the object of a patent (No. 532,314; application date, July 14, 1939), taken out by the Gas Light & Coke Company, W. Dieterichs, and F. C. Dines.

Referring to the construction shown in Fig. 1, the furnace is formed with an upright cylindrical muffle chamber 10, having a cylindrical wall 11 which encloses an annular air-heating space 12 formed in an outer cylindrical wall 13 moulded from a heat insulating substance. The lower end of the cylindrical wall 11 is spaced away from the bottom 14 of the furnace. The outer cylindrical wall is encased in a mild steel cover 15. The upper end of the cylindrical muffle chamber is closed by a removable lid 16, the rise and fall of which may be controlled by a foot pedal 17 operating through suitable lever and link mechanism 18 which permits the lid to be raised bodily. When raised, the lid may be swung to one side of the furnace by means of the handle 44. The lid may be formed from steel plate, which may be treated in known manner for the prevention of corrosion and is packed on its inner face with an insulating material 19. The lid is provided with a downwardly extending circumferential flange 9 which when the lid is closed projects into a sealing channel 8 secured to a fixed part of the furnace. The channel is filled with a suitable sealing



Temporary Offices for London Branch during hostilities:
MORDEN ROAD, MITCHAM, SURREY. Telephone No. 2728. Telegraphic Address: "Metrique, Phone, London."

material, such as sand, 7. The operating mechanism is such as to enable the lid to be swung to one side when in an open position so as to enable the articles to be treated to be introduced into and withdrawn from the muffle chamber without obstruction. Mounted in the lower end of the muffle chamber is a wire-mesh tray 20 arranged to support the articles to be treated and beneath this tray there is formed a compartment 21 in which an air impeller 22 is mounted to rotate about a vertical axis centrally located in respect of the muffle chamber. The cylindrical wall 11 of the muffle chamber is formed



from one-eighth inch mild steel sheet treated with aluminium and lined on its inner side with a layer of asbestos one-half an inch thick. The steel wall is flanged inwardly at 23 around its lower end and carries the tray. The upper end is secured in an opening formed at the top of the outer cylindrical wall of the furnace. The bottom of the outer wall is closed by refractory brickwork 24 in which are formed a number of burner chambers 25 arranged beneath the annular air-heating space 12. The annular air-heating space communicates with the top of the muffle chamber through a number of ports 26 circumferentially disposed in the cylindrical wall of that chamber. Arranged in the annular air-heating space are a number of vertically-disposed tubes each comprising an inverted U-shaped tube having one limb 27 longer than the other limb 28. The longer limb 27 is arranged to extend in a gas-tight manner through the brickwork 24 at the bottom of the furnace into the burner chamber 25. The smaller limb 28 of the tube is connected by an elbow-piece 29 to a conduit 30 leading into an annular flue-box 31, which is built into the outer cylindrical wall of the furnace and communicates with a flue outlet pipe 32. The annular flue-box 31 is rectangular in cross-section and is formed from one-eighth inch mild steel sheet. The brickwork at the bottom of the furnace is supported by steel plates having a number of holes 33 therein which register with upright passages 34 leading to the burner chambers. An arcuate burner pipe 35 is arranged beneath each burner chamber and burner tubes 36 extend up from these arcuate pipes through the hole and upright passages into the burner chambers, and terminate in jets 37. The burners thus provided may be of the luminous, semi-aerated, or bunsen types, sufficient space being allowed around the tubes for the passage of secondary air for combustion. The arcuate burner pipes are fed with gas through control cocks 38 arranged in branch passages 39 from a gas float. Each burner chamber also communicates through an outwardly-radiating passage 40 with an inspection and lighting opening 41 provided with a movable door 42. Located in each burner chamber is a small arcuate pipe 43 also supplied with gas from the gas float and formed with one or more pilot jets.

The impeller 22 is mounted on a shaft 45 which extends through a stuffing-box 46 in the brickwork at the bottom of the furnace. The shaft is driven by an electric motor 47 mounted on the framework 48 which supports the furnace, which shaft constitutes the armature shaft of the motor. Since the upper end of the shaft is directly heated from the muffle chamber means require to be provided for preventing heat being conducted along it to the armature. For this purpose, the shaft has secured to it a number of copper fins 49 arranged to radiate heat to the atmosphere. The impeller is of the paddle-wheel type so shapedas to draw in air through the upper side thereof and discharge it radially out through the periphery of the impeller. Thus, air is drawn downwardly through the muffle chamber and forced outwardly into the air-heating space 12, up through that space and then radially inwards through the ports 26 at the top of the inner cylindrical muffle chamber wall. The bottom of the furnace is supported on three pedestal legs 50 which are braced by a circular rail 51 welded to them. The link mechanism for opening and closing the lid has associated therewith an electric switch in circuit with the electric motor and so arranged that the motor is switched off when the lid is opened. It will be appreciated that with the above arrangement no air requires to be introduced into the muffle chamber, apart from that which is present when the lid is closed. Furthermore, the hot products of combustion are completely isolated from the charge of air.

Gas Fires

According to a patent (No. 532,346; application date, Aug. 5, 1939) granted to the Parkinson Stove Company, Ltd., and L. C. H. Athill, the burners of a gas fire are arranged in the lower ends of openings extending through an inclined refractory block above which is arranged a grid or fret supporting refractory material adapted to be heated by the burner flames or products of combustion. The openings in the refractory block are inclined at such an angle to the vertical that the upper end of each opening is wholly out of vertical alignment with the lower end—*i.e.*, a vertical line through any point in the upper end of the opening does not pass through the lower end of the opening.

One advantage claimed for the inclination of the openings is that heat reflected into the upper end of an opening strikes the wall of the opening and is conserved by the refractory block instead of passing directly downwards through the opening. A further advantage claimed is that any dirt or other debris entering into the upper end of the opening and falling substantially vertically engages the wall of the opening and slides downwardly in contact with the wall and passes out at the bottom without any risk of it entering and choking the burner.

The burner is mounted substantially centrally within the opening at its lower end and the air for combustion of the gas passes upwardly around the burner and prevents the burner from becoming overheated. The refractory block itself may be arranged at any convenient angle to the horizontal and will usually have its upper surface inclined at an angle of between 30° and 60° to the horizontal.

One practical design of gas fire in accordance with the invention is illustrated by way of example in the accompanying drawings, in which Fig. 1 is a front elevation of the fire in part section and with the fuel omitted. Fig. 2 is a vertical section of the fire. The drawings show only the essential parts of the fire, which may be fitted into a grate or surround of any desired design.

The fire is supported by a metal frame *a* of which the base is inclined at an angle of about 45°. The rear edge of the frame is supported by a cranked plate *b* and the front edge is adjustably supported by studs *c* adjustably screwed through lugs on the frame.

A refractory block *d* of substantial thickness rests on the frame and is supported at its lower edge by a channel-shaped support *e* of which the position is adjustable by means of screws *f* screwed through lugs on the frame and engaging with bosses *g* on the support. Elongated staggered openings *h* extending through the block are of greater depth at the top than at the bottom and the inclination of the upper and lower faces of the openings is such that the top edge of the upper face overhangs the bottom edge of the lower face and the bottom of the opening is wholly out of alignment with the top. By the term "depth" is meant the dimension of the opening at right angles to the front edge of the block.

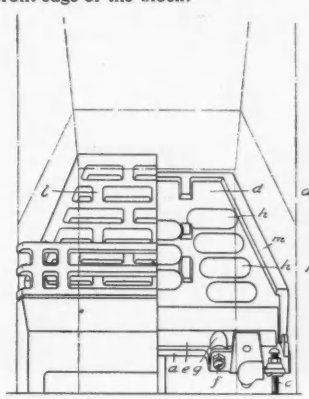


FIG. 1.

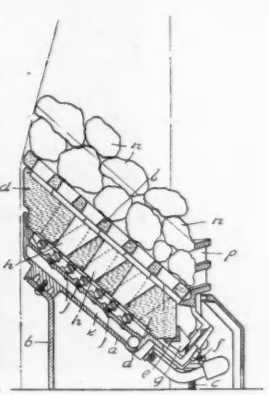
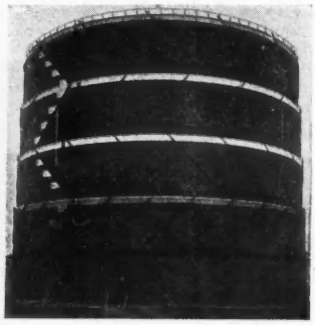


FIG. 2.

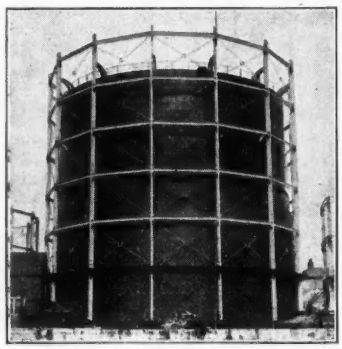
Burners *j* are mounted substantially centrally within the bottom end of each opening *h*, the burners being screwed into openings in the front wall of a gas passage *k* formed in the frame, and each burner is inclined at substantially the same inclination as the lower face of the opening. A grid or fret *l* of refractory material is supported over the block *d* on a flanged peripheral wall *m* of the frame and on this grid rest masses *n* of refractory material which are heated to a high temperature by the burners. The refractory masses at the front are supported by a ribbed wall *p* giving the effect of fire-bars.

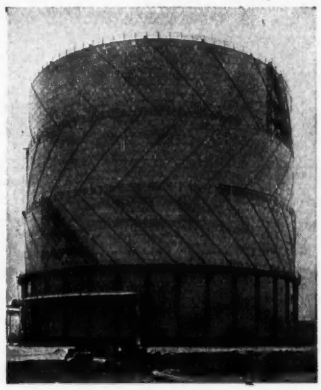
When the fire is in use heat reflected downwardly from the refractory masses *n* strikes and is conserved by the lower face of the openings *h* in the block *d*, and any dirt or debris falling into the openings *h* drops on to these faces and slides downwardly on contact therewith, so that it cannot enter the burners.



GASHOLDERS

GUIDE - FRAMED
SPIRAL
WATERLESS





PURIFIERS
CONDENSERS
STEEL BUILDINGS
STEEL TANKS

COAL AND COKE
HANDLING PLANT
SCRUBBERS
WASHERS

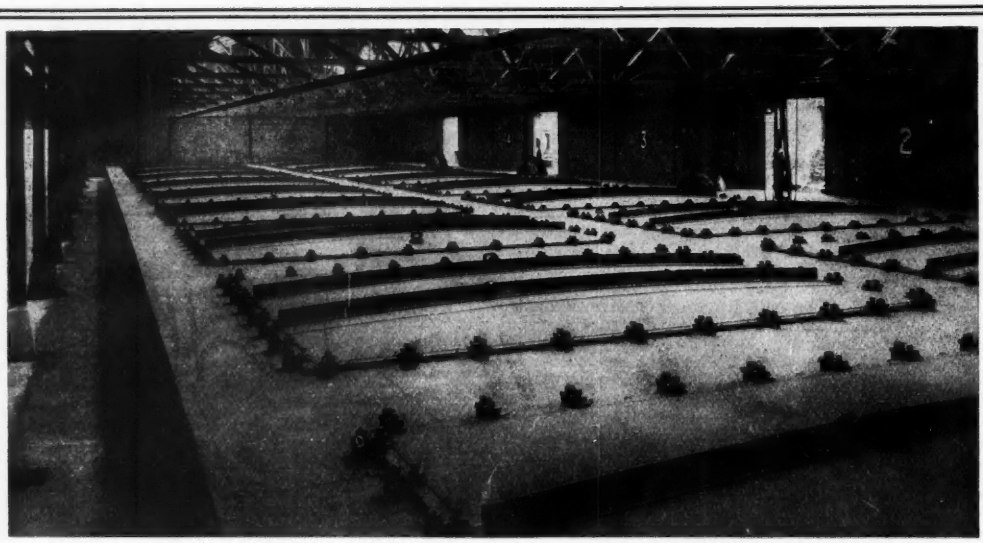
SAML. CUTLER & SONS, LTD.

LONDON

39 VICTORIA STREET, WESTMINSTER (481)

Telephones: ABBEY 3121

Telegrams: RETORTUS, SOWEST, LONDON



AT A CORPORATION GAS WORKS IN THE NORTH OF ENGLAND.

FIVE PURIFIERS 45 FT. x 35 FT. x 6 FT. WITH MILBOURNE OUTSIDE VALVES.

COMPLETE PURIFIER INSTALLATIONS

WITH C.I. OR STEEL BOXES

C. & W. WALKER, LTD.

DONNINGTON,
Nr. WELLINGTON—SHROPSHIRE

'Phone: Wellington-Shropshire 12

'Grams: "Fortress," Donnington, Shropshire

LONDON OFFICE—Temporary Address: DONNINGTON, WELLINGTON, SHROPSHIRE.

Gas Products Prices

The London Market

Mar. 10.

The prices of Tar Products in the London Market are to-day as indicated below: Pitch nominal; creosote 4¾d. to 5d. per gallon; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order is 2s. 5d.; pure benzole is 1s. 10d.; 95/160 solvent naphtha 2s. 3d.; and 90/160 pyridine about 15s.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' works.

The Provinces

Mar. 10.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North 9½d. to 10d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d. Heavy naphtha, North, 1s. 5d. to 1s. 6d Creosote, *ex* works, in bulk, North liquid and salty, 4¼d. to 4½d.; Scotland, 4¼d. to 4¾d.; low gravity, 4¼d. to 4¾d. Fuel Grade 4d. to 4¼d. Carbolic acid, 60's, 3s. 9d. to 3s. 10¼d. Naphthalene, £15 to £20. Salts, 75s. to 85s., bags included. Anthracene, "A" quality, 4¼d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5¾d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

Tar Products in Scotland

GLASGOW, Mar. 8.

Quietly steady conditions have prevailed in this market throughout the week.

Refined tar is, if anything, in better call with price unchanged in the home market at 4½d. to 4¾d. per gallon and 3¼d. to 3½d. per gallon for export, both f.o.r. naked.

Creosote oil continues to find a ready outlet at the following prices: Specification oil, 5d. to 5¼d. per gallon; low gravity, 6d. to 6½d. per gallon; neutral oil, 5¾d. to 6d. per gallon; all *ex* Works in bulk.

Cresylic acid shows no alteration with prices as follows: Pale, 99/100%, 2s. to 2s. 2d. per gallon; Pale, 97/99%, 1s. 9d. to 1s. 10d. per gallon; Dark, 97/99%, 1s. 6d. to 1s. 7d. per gallon; all *ex* Works in buyers' packages.

Crude naphtha as available commands round 6½d. to 7½d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha is 1s. 8½d. to 1s. 9d. per gallon for 90/160 grade, and 1s. 4½d. to 1s. 5½d. per gallon for 90/190 heavy naphtha.

Pyridines show some weakness with to-day's value in the region of 15s. per gallon for 90/160 grade and 17s. per gallon for 90/140 grade.

THIS WEEK'S ADVERTISERS

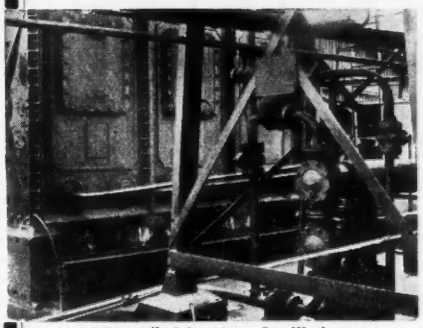
	PAGE
Aerospray Manufacturing Co., Ltd.	451
Alder & Mackay, Ltd.	482
Ashworth & Parker, Ltd.	454
Bale & Church, Ltd.	485
Belliss & Morcom, Ltd.	451
Blakeley, Firth, Sons, & Co., Ltd.	485
Braddock, J. & J.	476
Bratt Colbran, Ltd.	447
British Gas Purifying Materials, Co., Ltd.	485
Broadbent, J. C., & Co., Ltd.	485
Cowan, W. & B.	Cover III
Crookston, S., & Co.	455
Cutler, Samuel, & Sons, Ltd.	478
Dempster, Robert, & Sons, Ltd.	485
Diaphragm & General Leather Co., Ltd.	Cover II
Donkin Co., Ltd. (The Bryan)	Cover II
Ellison Insulations, Ltd.	485
Ether, Ltd.	453
Evans, Joseph & Sons (Wolverhampton), Ltd.	450
Fluxite, Ltd.	485
Frost, A. E.	485
Gas Meter Co., Ltd.	448
Gas Purification & Chemical Co., Ltd.	485
Glover, George, & Co., Ltd.	445
Glover, Thos., & Co., Ltd.	Cover I, 458
Goodall, Clayton & Co., Ltd	Cover IV
Grant, David, & Co.	450
Green & Boulding, Ltd.	484
Hamilton, Archd. H., & Co., Ltd.	455
Harrisons (London), Ltd.	485
Head, Wrightson, & Co., Ltd.	455
Holmes, W. C., & Co., Ltd.	487
Horseley Bridge & Thos. Piggott, Ltd.	454
Horstmann Gear Co., Ltd.	483
Humphreys & Glasgow, Ltd.	456
Jeavons, E. E., & Co., Ltd.	485
Jenkins, W. J., & Co., Ltd.	432
Johnson, C. H., & Sons, Ltd.	482
Keay, E. C. & J., Ltd.	488
Keith Blackman, Ltd.	488
Kings Patent Agency, Ltd.	486
Kirkham, Hulett, & Chandler, Ltd.	455
Main, R. & A., Ltd.	470
Menno Compressed Air Greasecup Co., Ltd.	483
Mewburn, Ellis & Co.	486
Mitchell, H., & Co.	455
Newton Chambers & Co., Ltd.	464
Parkinson Stove Co., Ltd.	467
Parkinson, W., & Co.	458
Peckett & Sons, Ltd.	483
Pulsometer Engineering Co., Ltd.	Cover IV
Radiation, Ltd.	468, 469
Reavell & Co., Ltd.	455
Ruscoe, John, & Co., Ltd.	483
Siebe, Gorman & Co., Ltd.	484
Smith Meters, Ltd.	472
Smith, Thos., & Sons (Rodley), Ltd.	484
Sperryn & Co.	457
Staveley Coal & Iron Co., Ltd.	453
Stanton Ironworks, Ltd.	486
Stein, John G., & Co., Ltd.	449
Strachan & Henshaw, Ltd.	445
Sutcliffe, Speakman & Co., Ltd.	449
Technological Institute of Great Britain	485
Thomas & Bishop, Ltd.	479
Trotter, Haines & Corbett, Ltd.	484
Walker, C. & W., Ltd.	478
Walker, Crosweller & Co., Ltd.	484
Waller, Geo. & Son, Ltd.	446
West's Gas Improvement Co., Ltd.	480
West's Piling & Construction Co., Ltd.	Cover IV
Westwood & Wrights, Ltd.	484
Withinshaw, A.	485
Woodall-Duckham Co., Ltd.	463

Appointments Vacant	486
Educational	485
Patents	486
Plant, &c.	485
Plants, &c., Wanted and for Sale	486

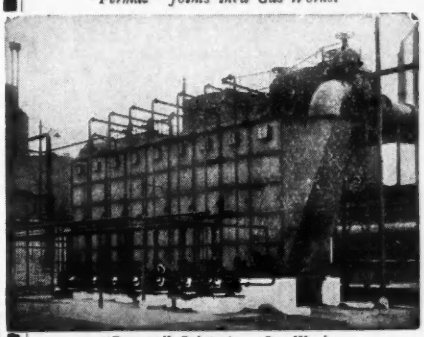
There's only one

Permac!

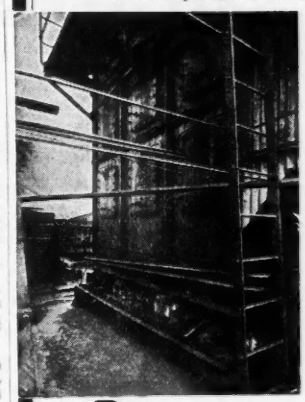
METAL-TO-METAL JOINTING MATERIAL.



"Permac" Joints in a Gas Works.



"Permac" Joints in a Gas Works.



"Permac" Joints in a Gas Works.

Be sure you get it!

Here is a selection of "Permac" joints photographed in various Gas Works. "Permac," the Metal-to-Metal Jointing, has been holding up difficult joints like these for over 25 years. Send for particulars.

Sole Manufacturers:

THOMAS & BISHOP LTD.

(formerly of 37, Tabernacle Street, London, E.C. 2)

Temporary address:

39, Arthur Road, Wimbledon Park, London, S.W. 19

For every size of works and every class of coal...

WEST'S

CARBONIZING PLANTS

GLOVER-WEST VERTICALS

WESTVERTICAL CHAMBERS

440 carbonizing plants have been built or are under construction by West's in 24 countries. Working results from a wide variety of gas coals have established the high efficiency and adaptability of the West systems:

WEST'S

GAS IMPROVEMENT CO · LTD ·

MILES PLATTING MANCHESTER 10

TELEPHONE—COLLYHURST 2961-2-3-4-5 · TELEGRAMS—STOKER, MANCHESTER

LONDON OFFICE TEMPORARY ADDRESS—BATH ROAD · HARMONDSWORTH · WEST DRAYTON · MIDDLESEX TEL.—WEST DRAYTON 2288-9

GAS STOCKS AND SHARES

The chief feature of Stock Exchange business last week was the strength of British Funds, and at the close 3½% War Loan reached 104 3/16, thus passing the 1938 peak of 104—2½% Consols which went *ex* div. on March 3 finished the week at 77¼. On the other hand home rails were quiet and dull. There was no improvement in the turnover among industrials, which generally were inclined to weaken. With the exception of Eagle issues the previous activity in oil shares was not maintained. Rubber and tea shares showed little change and continued dull and neglected.

There was a fair volume of business in the Gas Market and prices on the whole remained steadier than a week ago. The majority of price movements were on account of *ex* div. markings, and apart from these the only changes of note in the Official List were those of South Metropolitan 6% preference, which weakened 5 points to 80, while the reduced dividend announcement led to a similar fall in British ordinary. On the other hand Croydon 5% debenture rose 5 points to 97½. On the Provincial Exchanges it will be seen that Newcastle units advanced 6d. on support to 17s. 6d., but nominal quotations in the Supplementary List, apart from *ex* div., remained unchanged.

Among the latest dividend announcements appears that of the Alliance and Dublin Company, which is distributing 3% for the half-year to December last, against 3½% for the corresponding period a year ago, while the Directors of the British Gas Light Company are recommending a final dividend of 3%, making 6% for the year 1940, as compared with 7½% for 1939. The net profit in this case has been returned at £126,822, against £102,866 for the previous year.

Quotations on the London and Provincial Stock Exchanges

OFFICIAL LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 6.	Rise or Fall on week.
1,767,439	Sept. 16	7	7	Alliance & Dublin Ord. ...	103—108	...
374,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	90—95	...
957,608	Nov. 4	5	5	Assocd. Gas & Water U'd'cts Ord.	11/6—13/6	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	14/6—16/6	...
535,545	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	14/6—16/6	...
336,646	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—13/-	...
561,370	Feb. 17	7	7	Barnet Ord. 7 p.c.	95—100	...
300,000	Oct. 14	1/9 3/8	1/4 3/8	Bombay, Ltd.	19/6—21/6	...
690,407	Feb. 24	7	7	Bournemouth 7 p.c. max. ...	102—112	...
362,025	Dec. 16	4	4	Do. 4 p.c. Deb. ...	87—92	...
659,955	March 3	4 3/8	2½	Brighton, &c., 5 p.c. Con. ...	58—68*	—2
855,000	Sept 30	8	6	Brit. Gas Light Ord.	70—80	—5
545,000	Dec. 16	5½	5½	Do. 5½ p.c. 'B' Cum. Pref	105—115	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb.	75—80	...
10,000	Nov. 6 '33	6	4	Cape Town, Ltd., 4½ p.c. Cu. Pf.	¼—¾	...
626,860	Feb. 3	6	6	Cardiff Con. Ord.	87—92	...
24,500	Sept. 23	7	7	Colombo 7 p.c. Pref.	19/—21/-	...
764,169	Oct. 7	-/11.48	-/11.48	Colonial Gas Assn. Ltd. Ord. ...	14/—16/-	...
400,000	,,	1/3.30	1/3.30	Do. 8 p.c. Pref. ...	19/—21/-	...
1,748,935	July 22	2	3	Commercial Ord.	28—38	...
620,000	Dec. 9	3	3	Do. 3 p.c. Deb.	57—62	...
286,344	Feb. 17	5	5	Do. 5 p.c. Deb.	85—90	...
807,560	Feb. 24	6	6	Croydon sliding scale	80—85	...
644,590	,,	5	5	Do. max. div.	75—85	...
620,385	Dec. 30	5	5	Do. 5 p.c. Perp. Deb. ...	95—100	+5
179,500	Feb. 10	5	5	East Surrey 'B,' 5 p.c.	60—70	...
176,461	Dec. 16	5	5	Do. 5 p.c. Deb. (Irred.)...	87—92	...
250,000	Nov. 11	4	6	Gas Consolidation Ord. 'B' ...	13/6—14/6	...
250,000	Nov. 11	4	4	Do. 4 p.c. Red. Cum. Pref.	15/—17/-	...
19,122,910	July 29	3 3/8	4½	Gas Light & Coke Ord. ...	10/6—11/6a	...
2,600,000	,,	3½	3½	Do. 3½ p.c. max.	40—45	...
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	61—66	...
2,993,000	July 8	3 3/8	3 3/8	Do. 3 3/8 p.c. Red. Pref. ...	68—73	—2
8,602,497	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	70—75	...
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	101—106	...
2,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	99—104	...
700,000	Sept. 9	3½	3½	Do. 3½ Red. Deb. ...	80—85	...
5,600,000	May 13	4	8	Imperial Continental Cap. ...	42—47	...
43,820	Jan. 27	3½	3½	Do. 3½ p.c. Red. Deb. ...	75—80	...
231,978	Feb. 24	5	5	M.S. Utility 'C' Cons.	66—71	...
918,657	,,	4	4	4 p.c. Cons. Pref.	70—75	...
675,000	Nov. 11	14	14	Montevideo, Ltd.	52—57	...
300,000	Nov. 18	7	9	Oriental, Ltd.	105—115	...
368,537	Dec. 9	8	6½	Plymouth & Stonehouse 5 p.c.	88—98	...
621,667	Feb. 3	7½	7½	Portsmouth & Gosport Cons.	90—95	...
648,999	Sept. 16	1/1	1/1½	Severn Val. Gas Cor. Ld. Ord.	13/—15/-	...
597,972	,,	-/10½	-/10½	Do. 4½ p.c. Cum. Pref. ...	15/6—17/6	...
2,528,714	Sept. 2	1/-	-/7½	South East'n Gas Cn. Ld. Ord.	7/—9/-	...
1,000,000	March 3	-/10½	-/10½	Do. 4½ p.c. Red. Cum. Pref.	13/6—15/6*	—/6
1,068,869	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	10/—12/-*	—/6
6,709,895	Aug. 5	4	4	South Met. Ord.	38—43	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	75—85	—5
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	60—65	...
1,895,445	Dec. 30	3	3	Do. 3 p.c. Perp. Deb. ...	59—64	...
1,000,000	Jan. 15	5	5	Do. 5 p.c. Red. Deb. ...	98—103	...
1,543,795	Feb. 24	4	2	South Suburban Ord. 5 p.c. ...	55—65	...
512,825	,,	5	5	Do. 5 p.c. Perp. Pref. ...	78—83	...
500,000	,,	4	4	Do. 4 p.c. Perp. Pref. ...	60—65	...
250,000	,,	3 3/8	3 3/8	Do. 3 3/8 p.c. Red. Pref. ...	78—83	...
888,587	Dec. 16	5	5	Do. 5 p.c. Perp. Deb. ...	93—98	...
750,541	Feb. 10	5	2	Southampton Ord.	50—60	...
350,000	Feb. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	91—96	...
1,076,495	Feb. 24	5	5	Tottenham & District Ord. ...	65—70	...
338,555	,,	5	5	Do. 5 p.c. Pref.	78—83	...
453,380	Dec. 9	4	4	Do. 4 p.c. Perp. Deb. ...	76—81	...
1,247,505	May 20	4	6	U. Kingdom Gas Cor. Ord. ...	13/—15/-	...
1,085,952	Nov. 25	4½	4½	Do. 4½ p.c. 1st Cum. Pref. ...	13/6—15/6	...
772,709	,,	4	4	Do. 4 p.c. 1st Red. Cum.Pref.	13/—15/-	...
745,263	Dec. 16	4½	4½	Do. 4½ p.c. 2nd Non.Cum. Pf.	12/—14/-	...
1,200,000	Sept. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	85—90	...
380,606	Aug. 5	7	6⅔	Uxbridge, &c., 5 p.c.	80—90	...
1,371,138	March 3	4	4	Wandsworth Consolidated ...	65—70*	+2½
2,525,768	,,	4	4	Do. 4 p.c. Pref.	60—65*	...
1,343,964	Dec. 16	5	5	Do. 5 p.c. Deb.	92—97	...
383,745	,,	4	4	Do. 4 p.c. Deb.	75—80	...
558,342	Feb. 24	5	5	Watford & St. Albans Ord. ...	82—87*	...
300,000	Dec. 9	3½	3½	Do. 3½ p.c. Red. Deb. ...	84—89	...

SUPPLEMENTARY LIST

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations March 6.	Rise or Fall on week
351,685	Dec. 16	5	5	Brighton, &c., 5 p.c. Perp. Deb.	88—93	...
28,700	,, 17	5½	5½	Do. 5½ p.c. Red. Deb. 1942 ...	95—100	...
415,250	,, 23	4	4	Bristol Gas Co., 4 p.c. New Deb.	83—88	...
140,205	Feb. 3	7	7	Cambridge, &c., 7 p.c. Cons. 'B'	100—110	...
295,932	March 3	5	5	Cheltenham, 5 p.c. Cons. Ord....	85—90*	—3
42,500	Dec. 16	4	4	Do. 4 p.c. Perp. Deb....	75—80	...
150,000	Feb. 24	4	4	Croydon Gas, 4 p.c. Pref. (Irr.)	65—75*	...
130,000	Dec. 30	4	4	Do. 4 p.c. Deb. ...	75—80	...
146,700	Feb. 10	5½	5½	East Surrey, 5½ p.c. Pref. 'A' ...	80—90	...
53,220	,, 10	6	6	Do. 6 p.c. Cum. Pref. ...	90—100	...
117,425	Feb. 5	8	8	East Wight, 5 p.c. Cons. Ord. ...	100—110	...
...	Aug. 19	6	4	Eastbourne, 'B' 3½ p.c.,...	65—75	...
239,135	Nov. 11	5	5	Gas Consolidation 'A' Ord. (£1)	13/—15/-	...
156,600	Feb. 24	5	5	Hampton C't, 5 p.c. Cons. Ord.	67—72*	...
18,000	Dec. 2	7	7	Malta & Med'n., 7 p.c. 1st Pref.	50—60	...
10,845	,, 2	7½	7½	Do. 7½ p.c. 2nd Pref.	50—60	...
50,000	Feb. 24	£5 19 6	£5 4 6	Mid. South. Util., 'A' Cons. 5 p.c.	60—70*	...
65,000	Aug. 12	5	5	North Middlesex, 5 p.c. Pref. ...	87—92	...
70,000	Sept. 9	5	5	Plymouth & Stone., 5 p.c. Deb.	87—92	...
76,501	Dec. 30	4	4	Reading, 4 p.c. Perp. Deb.	70—75	...
74,777	Sept. 30	4	4	Romford, 4 p.c. Debs. (Reg.) ...	77—82	...
21,000	Dec. 16	5	5	Slough, 5 p.c. Perp. Deb. ...	87—92	...
211,740	,, 30	5	5	Southampton, 5 p.c. Red. Deb.	90—95	...
363,575	Dec. 30	5	5	Tottenham, 5 p.c. Reg. Red. Mt.	94—99	...
202,019	Oct. 14	6½	6½	Tunbridge Wells, 4 p.c. Scale ...	67—72	...
135,257	June 10	5	5	Uxbridge &c., 5 p.c. Perp. Deb.	88—93	...

PROVINCIAL EXCHANGES

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Feb. 28.	Rise or Fall on week
47,756	July 26	6	5	Bath Cons.	94—98	...
122,577	July 22	7	6	Blyth 5 p.c. Ord.	100—105	...
1,667,250	Feb. 24	5	5	Bristol, 5 p.c. max.	86—88*	—2
120,420	Dec. 16	4	4	Do. 1st 4 p.c. Deb.	92½—94½	...
415,250	,,	4	4	Do. 2nd 4 p.c. Deb. ...	91—94	...
328,790	,,	5	5	Do. 5 p.c. Deb.	107—110	...
157,150	Feb. 3	5	6½	Chester 5 p.c. Ord.	98—101	...
92,500	Dec. 16	4	4	Do. 4 p.c. Pref.	79—81	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	79—84	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	93—97	...
542,270	Feb. 10	6	9	Derby Cons.	98—103	...
55,000	Dec. 16	4	4	Do. 4 p.c. Deb.	75—80	...
10,000	Aug. 19	10	10	Great Grimsby 'A' Ord. ...	155—165	...
6,500	,,	10	10	Do. 'B' Ord. ...	155—165	...
79,000	,,	10	10	Do. 'C' Ord. ...	145—155	...
732,000	Feb. 24	4	4	Hartlepool G. & W. Cn. & New	61—63*	...
2,167,410	Feb. 17	6	6	Liverpool 5 p.c. Ord.	88½—92½	...
245,500	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	97½—100½	...
306,083	July 15	4	4	Do. 4 p.c. Deb.	98—100	...
20,000	Dec. 23	5	5	Long Eaton 5 p.c. Pref.	9—11	...
80,000	,,	5	5	Do. 5 p.c. Deb.	87—92	...
2,430,267	Feb. 10	5	5½	Newcastle and Gateshead Con.	17/—18/-a	+—/6
682,856	,,	4	4	Do. 4 p.c. Pref.	79—81	...
776,706	Dec. 23	3½	3½	Do. 3½ p.c. Deb.	80—85	...
277,285	Oct. 21	5	5	Do. 5 p.c. Deb. '43 ...	97—102	...
274,000	July 26	5	5	Newport (Mon.) Ord.	89—93	...
13,200	Sept. 16	8⅔	7	Pontyp'l Gas & W. 10 p.c. 'A'	11½—12½	...
13,600	,,	6	5	Do. 7 p.c. 'B'	9½—10½	...
40,000	,,	5	6	Do. 7 p.c. 'C'	9½—10½	...
106,280	Feb. 3	10	10	Preston 'A' 10 p.c.	157—167	...
188,219	,,	7	7	Do. 'B' 7 p.c.	113—123	...
1,806,339	Feb. 24	6½	6½	Sheffield Cons.	113—115*	—1
95,000	Jan. 6	4	4	Do. 4 p.c. Deb.	96—98	...
332,351	Feb. 3	6	6	Sunderland 6 p.c. max. ...	107—112	...
140,778	Feb. 12	5	5	Weston-super-Mare Cons. ...	79—84	...
64,338	Dec. 30	4	4	Do. 4 p.c. Deb.	80—85	...
33,340	,,	7½	7½	Do. 7½ p.c. Deb.	135—140	...

a.—The quotation is per £1 of Stock. * Ex. div. † Price free of income-tax.

"A & M" PREPAYMENT METERS

I.G.E. D.1

Two types of Prepayment Meter are offered, the Single Coin Disc-change for pennies or shillings, and the Optional with or without Dual Coin adjustment. Accuracy, simplicity and durability are the characteristics of both these attachments.

ALDER & MACKAY LTD.

EDINBURGH - LONDON - BRADFORD AND BRANCHES

"JOHNSON" BALANCED-POWER RAMMERS
NOW IN USE FOR RAPID BACK-FILL OF CRATERS Etc.

QUICK WORK With 'JOHNSON' RAMMERS

The 'Johnson' Rammer saves time on three jobs —light duty and heavy duty ramming and light pile driving. 'Johnson' Rammers are working on filling-in Bomb Craters and give an astonishing performance. Low fuel costs; no wastage; minimum upkeep; magneto operated; BALANCED Power! The Rammer with the fewest working parts. Write for Leaflets.

JOHNSON
BALANCED-POWER RAMMER

Can be Operated on ANY TYPE of FUEL, INCLUDING POOL PETROL

Magneto operated. Fewest working parts, has accurate jumping height—Not too high for easy control—Not too low, no loss of power! Write for leaflets.

C. H. JOHNSON & Sons, Ltd., Dept H, Adswood Rd., Stockport
(Est. 1790)
Telephone: STOckport 2644/5.

Manchester Office: Albert St., off Smedley Rd., M/c(8) *Tel.: COLlyhurst 1921/2*

C.H.J. 293